JULY 1956

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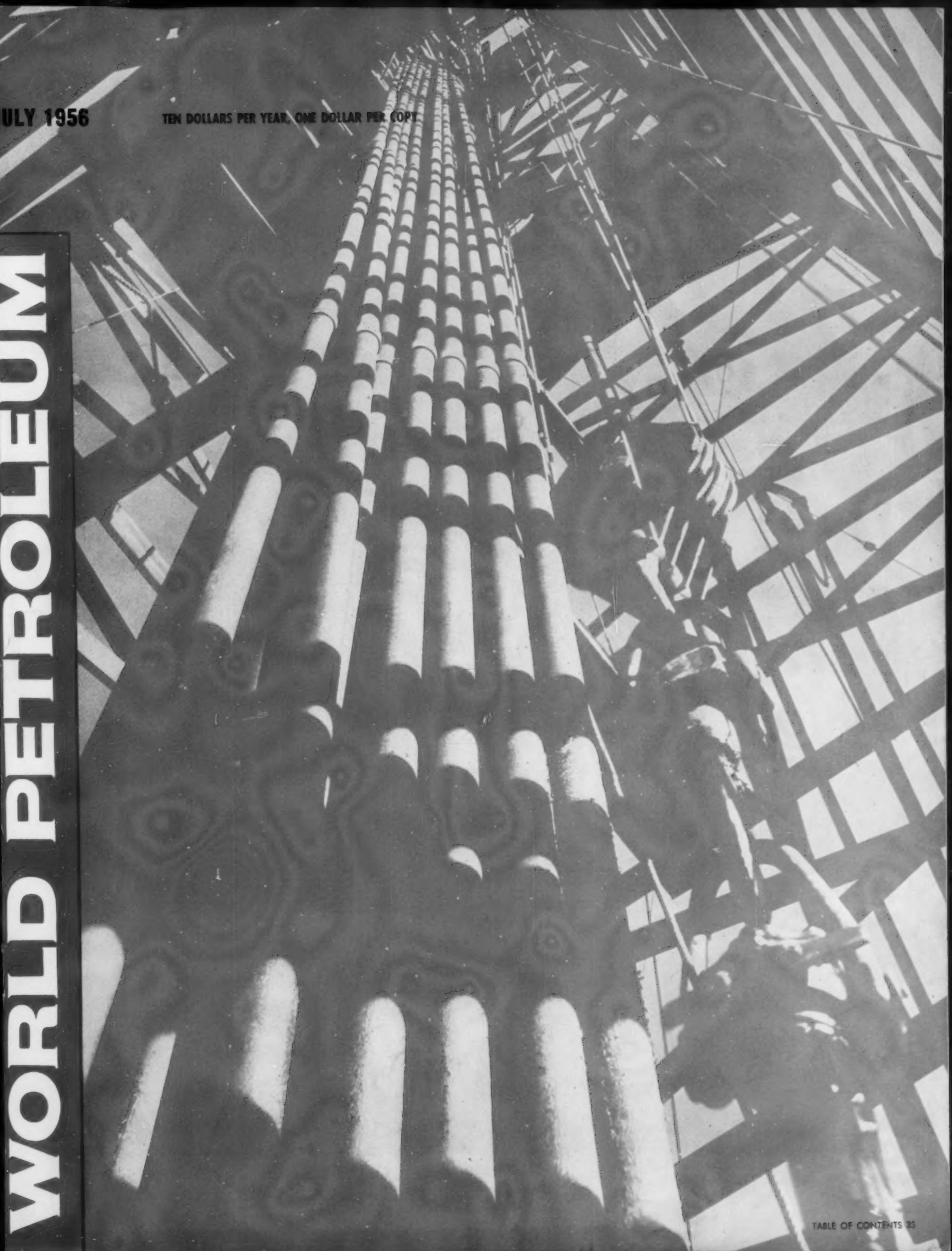

TABLE OF CONTENTS 35

on hot weather motor fuel troubles!

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So necessary for superior performance after it reaches your customers' fuel tanks.

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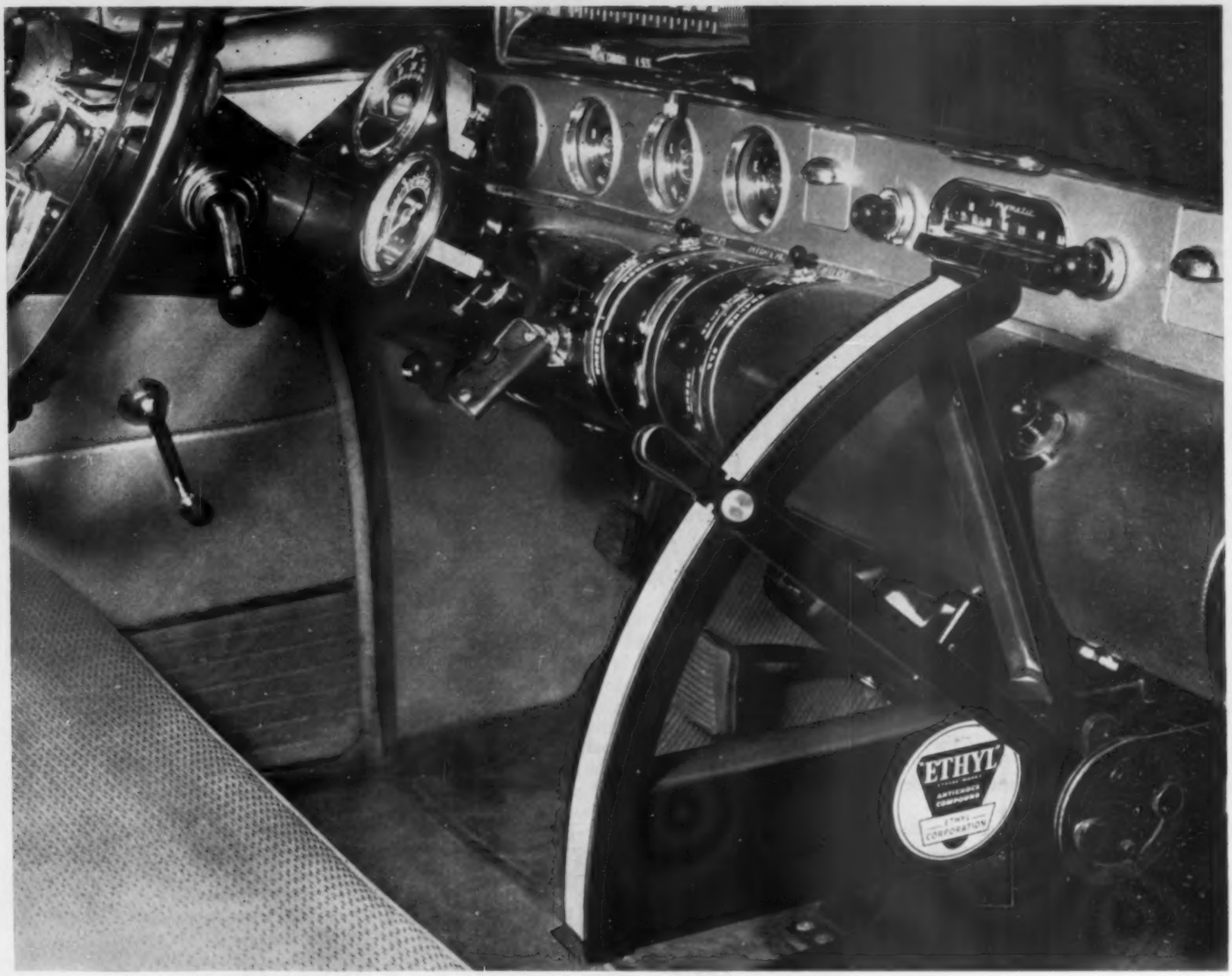

Minimum instrumentation needed for fuel rating includes: Removable spark advance quadrant, calibrated crankshaft pulley, auxiliary fuel system, tachometer and vacuum gauge.

How Ethyl Research equips a car for accurate fuel ratings

Ethyl Research has for years been active in developing more accurate and economical ways of obtaining fuel ratings on the road—offering refiners convenient methods for evaluating their gasoline stocks.

At Ethyl Laboratories, we have found that the various road rating procedures can be adequately handled by a grouping of just five instruments, some of which can be seen in the picture above. But we have discovered that the addition of other key equipment can facilitate your road testing operations.

Our people have accumulated hundreds of thousands of miles of road testing experience with this equipment. If you would like more information about this important subject, please contact your Ethyl technical representative.

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McCullough Back-Off Service Aids in Recovery of an Extra 3600′ of Stuck Pipe

In some stuck pipe conditions McCullough's Magna-Tector (Free Point Finder) will indicate that working the pipe may free it further down the hole. In this instance the stuck drill pipe was actually loosened 3,600′ below the original sticking point.

Operator was drilling at 5,668′ with 3½″ Full Hole Drill Pipe when pipe stuck. This was a 32° angle directional well.

● McCullough was called to run their combination Magna-Tector, String Shot Back-Off. Lowest free point was found at 1,900′. However, the Magna-Tector reading indicated that the drill pipe might be freed further down the hole.

Pipe was worked for 2½ hours and the combination Magna-Tector, String Shot Back-Off was again run. Pipe was found to be free at 5,500′ at the top of the drill collars. The String Shot Back-Off was positioned and fired and pipe was recovered from that point — a bonus of 3,600′ of drill pipe.

McCullough's new combination "One Trip" Back-Off Service obtained the free point reading and fired the back-off shot on a single trip in the hole. Thus, all free pipe was backed off and started out of the well almost immediately after the lowest free point had been found — and before it had a chance to re-stick further back up the hole.

Magna-Tector Helps Save 12 Days Fishing Time on Stuck Pipe Job

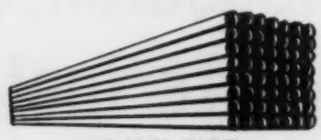
Operator Estimated 21 Days to recover 7760′ of Stuck Drill Pipe — Job Actually Completed in 9 Days with Aid of McCullough Back-Off Service.

The time-saving benefits of McCullough Back-Off Service in pipe recovery operations were strikingly demonstrated in this deep California well.

Operator was drilling at 11,360′ when 4½″ O.D. drill pipe became stuck. Only surface casing had been set and hole was open from 500′ to 11,360′.

McCullough was called immediately. The Magna-Tector (Free Point Finder) located the lowest free point in the stuck string at 3,600′. A String Shot Back-Off was fired at that point and the free pipe was removed from the hole.

At the time of the first back-off the Drilling Superintendent advised his head office that it would require an estimated 22 washover operations, 22 String Shot Back-Off shots and 21 days of rig time to recover the remaining 7,760′ of stuck drill pipe. However, due to reliable free point determination, the job was completed in only nine days. After each washover operation, McCullough's Magna-Tector was run to confirm that the washed-over pipe was free. In each instance the Magna-Tector discovered that pipe was free a considerable distance below the lowest washover point. McCullough's String Shot Back-Off successfully loosened the lowest free joint in every case and permitted fast recovery of the freed sections.



Call for—McCULLOUGH BACK-OFF SERVICE

McCullough "One Trip" Back-Off Service is now available in most service areas — performs all back-off operations in one electric wire line run in the hole — ask your McCullough Service Engineer.

Instead of 22 separate washover and back-off operations, the use of McCullough Back-Off Service enabled completion of the job in only four recovery operations.

Count the savings this operator made through his foresight in calling for McCullough Back-Off Service. Saved — 18 String Shot Back-Off shots — 18 separate washover operations — 12 days rig time.

It pays to call for McCullough Back-Off Service. You'll save time — save pipe — save money!

McCullough® TOOL COMPANY

Cable Address: MACTOOL

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AP3/1173

Washington PIPE LINE

By Joseph B. Huttlinger

Seaton Heads Interior

Fred A. Seaton, the new Secretary of the Interior, is a forceful man with a mind of his own, who is immensely capable. An astute politician, and one of the most popular men in Washington, he came here at the end of 1951 to fill the unexpired term of the late Senator Kenneth Wherry.

As secretary, he is the chief government officer as far as oil and gas matters are concerned. Points of contact are numerous.

Oil and gas leasing in the outer belt of the offshore lands are run by the Department of the Interior. Also under the department are public lands including wildlife refuges, the bureau of mines, geological survey, coal-to-oil studies, Alaskan matters, fast tax writeoffs for new petroleum facilities, expansion goals for the oil and gas industry, and cooperation with the Foreign Petroleum Supply Committee and the National Petroleum Council. Some of this work is coordinated by the office of Oil and Gas of Interior.

Secretary Seaton will have a chance to speak a word for oil on such matters as the depletion allowance and controls over natural gas prices. He will get into oil imports as a member of the Cabinet Committee on Fuels Policy.

There was little indication of his attitude toward oil when he took office June 8—the day President Eisenhower went to the hospital. He did vote against turning over offshore oil lands to the states. There is a rumor he suggested a veto of the natural gas bill this spring.

Mr. Seaton tries to be publisher of his 11 newspapers and operator of his three radio stations in the Midwest. He gets sidetracked into politics. He was executive secretary with Harold Stassen's try for the Presidency in 1948, and advisor to the Eisenhower campaign in 1948.

Mr. Seaton became Assistant Secretary of Defense in September, 1953, and moved to the White House February, 1955, to become deputy assistant to the president. He is even closer to the President: Seaton's father, as secretary to Sen. Joseph L. Bristow of Kansas, helped obtain the Eisenhower West Point appointment.

The post became vacant when Douglas McKay resigned to run for the Senate in Oregon. As Seaton takes over, friends recall what they used to say at the White House of him. "If you don't know, better ask Fred Seaton."

Impact of Highway Bill

The American petroleum industry is going to be affected in many ways by the new highway bill—the largest single construction bill in the history of the civilized world.

As it stands, the bill will provide for more than $50 billion worth of highways over the next 13 years. And state and local money will be freed for other spending for highways—perhaps another $50 billion worth.

To raise the money, $38 billion of which will come from the federal government, and the rest from states, new taxes are being levied.

Thus, the federal tax on gasoline will go up, effective July 1 of this year, to three cents a gallon from the present rate of two cents. Taxes on diesel fuel and special motor fuel; on tires and inner tubes; on trucks and the like will go up. One estimate is that the average motorist will pay $6.50 a year in new taxes; that the large truck will pay an extra $400 a year. Off-highway users will obtain certain refunds.

The bill provides that the 40,000-mile interstate system, which is to be improved and completed, will have federal control of exits and entrances and of service stations and the bill provides competition among oil companies and gasoline dealers in this field by barring monopolies, now granted on some U. S. highways.

The bill as passed by the House, would forbid the location of service stations on the rights of way of the highways. This would bar states, for instance, from demanding high royalties from gasoline service.

Charles Z. Hardwick, executive vice-president of the Ohio Oil Co., told a Washington conference recently that "the best" way to handle service is the service road or the feeder route.

Oil Field Equipment Sales

Sales of oil field machinery and equipment, and tubular goods during 1955 came to $1,551,716,320, according to a summary of reports compiled by the U. S. Department of Commerce.

This was a gain of 18% over the total for a year earlier, $1,313,763,930. The compilation was made public by the Agricultural, Construction, Mining and Oil Field Equipment Division of the Business and Defense Services Administration of the department.

The figures came from a questionnaire to 480 U. S. manufacturers, which drew 439 plants replying.

Of the figures, sales of machinery and equipment came to $896,866,771; services such as cementing, formation tests, fracturing and the like came to $199,733,087; sales of tubular goods came to $455,-116,462. The tubular goods sales were $364,426,915 during 1954.

Total steel requirement for the industry in 1955 was 3,211,750 tons—both carbon and alloy steels. This does not include imported pipe, inventory withdrawals, line pipe used as oil country goods and second-hand pipe.

On the basis of reported tonnage, USDA estimates a 1955 requirement of 14.2 tons of steel for each 1,000 feet of hole drilled as compared with the 1954 requirement of 13.6 tons.

The U. S. oil and gas industry completed 56,682 wells during 1955 for a total of 226,270,000 feet. The average depth of the wells was 3,992 feet.

Pro-ration Study Postponed

Attorney General Herbert Brownell, Jr., apparently is trying to avoid making a study and report on the Interstate Oil Compact. First he asked Congress not to ask for the study. Congress did so anyway, a year ago. Mr. Brownell then asked an astonishing $700,000 to make the study, 25% of entire budget of the anti-trust division. Congress slashed this to $25,000, amid suggestions Mr. Brownell is trying to make the study "absurd."

Now Brownell says he can't meet the July deadline for the first report, because of no staff. Some say he may need another year, unless prodded by anti-oil Senators.

NATO Petroleum Committee Meets

Hugh A. Stewart, director of the office of Oil and Gas of the Department of the Interior, is head of the U. S. delegation to a meeting of the petroleum planning committee of the North Atlantic Treaty Organization in Paris, June 21.

Frederick S. Lott, assistant director of the OOG, is attending as chairman of the committee's working group. Others attending are Earl R. Beckner, chief of the fuels division of the Department of State; and Maj. Gen. Louis Cotulla of the office of petroleum logistics of the Department of Defense.

India to Send Oil Experts to U. S.

A team of petroleum officials from India is considering a trip to the United States to study whether government or private industry best runs the petroleum industry.

The head of India's Ministry of Natural Resources and Scientific Research, or the deputy head, accompanied by a geologist and mining engineer, would be in the party.

The U. S. has offered to throw open its doors, to the extent of paying part of the cost through the International Cooperation Administration.

The group also would visit Canada, Mexico, Venezuela and return home by way of Algiers and France.

Re-Examination of Oil Imports Formula

The U. S. is taking a new look at the formula as to the proper levels of imports of crude oil and residual oil, it is announced.

The restudy is to determine if the present formula still is valid, or if it should be revised. While there was no statement about it, it is believed any revision would be to allow in more oil.

The present formula was announced Feb. 26, 1955, by a special Cabinet Committee on Energy Supplies and Resources Policy, of which Dr. Arthur S. Fleming, defense mobilizer, is chairman.

Merger Law Opposed

U. S. oil producers are objecting to legislation designed to slow down business mergers. They told a Senate Judiciary Sub-committee a 90-day notice measure would hamper buying and selling of oil and gas leases.

The measure would call for companies wanting to merge to give 90 days' notice to the government if the combined assets of both companies are $10 million or more. The House passed the measure, but the Senate has been taking a long look at it.

FPC Members Named

After three and a half years, President Eisenhower has named all five members of the U. S. Federal Power Commission. Arthur Kline of Cheyenne, Wyo., a Republican, is the final one. He was named to a five-year term starting June 22, 1956.

He takes the post being left by Claude L. Draper, who has been on the commission since 1930—an appointee of President Herbert Hoover. Often, Draper was at odds with oil and gas men.

Currently, the FPC is studying major gas company plans to bring natural gas into the United States from both Canada and Mexico.

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and the industrial giant called "Offshore"

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International News and Notes

U.S.S.R. Develops Electric Bottom Hole Motor

With the turbine drill beginning to interest American industry, news of still another Russian innovation is appearing. Over 120,000 feet were drilled electrically in Russia with bottom hole motors during 1954. Among the advantages listed for bottom hole electric drilling are less pipe wear, more constant power, and better control of torque. Among disadvantages are more frequent repairs, and lack of adequate experience on drilling speeds.

The following summary is of an article[1] which recently appeared in Russia. It lists the main points of experience with electric drilling in the USSR. In this system, as in turbine drilling (See WORLD PETROLEUM, March and April 1955.) power is applied directly to the bit, which rotates without turning the drill pipe.

During 1954, 22 wells with a total depth of 121,707 feet were drilled electrically against 16,614 feet in 1950 when two electric rigs were working. The Soviets listed the following findings:

The power transferred to the bit and its rpm remain constant while in turbine drilling, bit efficiency and rpm depend chiefly on pump efficiency, depth of bore hole, and weight on the bit.

The pipe drill moves very little in either turbine or electric drilling with the result that wear is reduced, lighter pipe and simpler tool joints can be employed. Eight to ten wells can be drilled electrically to 5,600 feet with the same drill pipe in electric drilling. Breakdowns of the bit are almost nonexistent, according to the Soviets.

The maximum pressure carried on the bit is 44,000 to 62,000 pounds. If pressure is to increase, the power must be raised. Less experience is needed in electric than in turbine drilling to adjust torque on the bit in such a way as to achieve a miximum penetration. The automatic pressure regulator BAR-1 regulates the right amount of torque on the bit or its timely retraction, thus almost eliminating bit damage.

Electrically-driven bits reach rotation speed and stop quickly while turbine-driven bits need pick-up time and stop only after slush pressure on the blading of the turbine ceases.

Electric drills with 520 rpm are already being mass-produced. Tests with 400, 520 and 670 rpm motors showed that penetration increases with higher rpm. Tests are now carried out with 670 and 900 rpm motors to determine most economic rotation speed. For each electric drill a 500 KVA transformer is being used, although normal capacity of the drills amounts to only 150 KV. The transformer is given three windings to supply additional current for rig work.

For the first time in 1954 the AJAG-3-150 centrifugal slush pumps were used. These need no air chamber and are much smaller than piston pumps. The centrifugal pumps have a capacity of 5,300 cubic feet per hour. They cannot as yet handle thick mud.

Repairs on electric drilling are more frequent and more time-consuming (about 44 hours more per well) than in turbine drilling. The contact joints in the power cable constitute a problem. Trip time is affected by the fact that power cable runs through the drill pipe.

Since electric drilling can be carried out with only one slush pump, it is intended to make more use of electric drilling on the Tuymazy oil field.

In the past several months the Soviet Union has opened the iron curtain to export a wide range of oil equipment, exclusive of crude and products shipments, which have been increasing daily.

The most recent of these exports is the shipment of three drilling rigs to India. The price was $1.34 million, including installation by the end of 1956 free of charge, plus seismic equipment for exploratory work in the states of Punjab and Rajastan. A total of 66 Soviet experts are to supervise the rig installations and train Indian personnel in their use for six months. This is in addition to the recent survey by Soviet geologists on invitation from the Indian government, which covered the country and resulted in recommendations that in the next five years exploration be concentrated in the states of Rajastan and Punjab and that geological work be done on the Ganges Valley of western Bengal, the Cambay area and the Madras Coast.

A recent report from Syria states that a group of Yugoslavian geologists had received exploratory rights. The group will cover the entire country, using Austrian and Soviet equipment. Soviet turbodrills, produced under license by Mannesmann-Trauzl A.G. in Austria and delivered to Yugoslavia, have been shipped to Syria and the lack of any protest from Russia indicates the arrangement had the government's approval.

In Austria, where the Russians controlled the majority of oil production facilities until mid-1955, the Soviet Union has declared its willingness to supply Austria with three devices, used to control turbodrills in directional drilling. Delivery date was five to seven weeks. The accessory is used with the Ts-3 turbodrills which the Russians turned over to Austria on leaving the Austrian fields.

In France, Hughes Tool Co. has made an agreement to manufacture rock bits for the Neyrpic S.A. turbodrill which was developed by Neyrpic in France. Hughes will develop the high-speed hydraulic drilling bits but will not manufacture turbodrills itself. Hughes will have access, however, to Neyrpic's information on the turbodrill. Alfred Wirth & Co. of Erkelens, Germany, has been granted an exclusive license over the Neyrpic turbodrill in Germany and will rent the drill and Hughes' bits to other countries.

Meanwhile Dresser Industries, whose executive vice president, J. B. O'Connor, recently made an agreement with the Russians to manufacture the Russian turbodrill in America, has announced it will manufacture the Neyrpic turbodrill. This followed the U.S. government's refusal to allow Dresser to export the metallurgical information which was to be given in return for turbodrill technical advice and manufacturing rights.

Dresser has been granted an exclusive license by Neyrpic to build the new hydraulic turbine in Canada, United States, Mexico and Venezuela, and will put at Neyrpic's disposal the Dresser worldwide field service organization.

S. M. James

Dresser is sending field drilling engineers over to France to work with Neyrpic on hydraulic drilling problems, according to Mr. O'Connor. He further stated that he considers Neyrpic facilities at Grenoble some of the finest in the world for research and development work on hydraulic problems.

Austrians to Produce Turbo-Drills

The Mannesmann-Trauzl A.G., Vienna-Strebersdorf, is now producing drilling rigs.

The factory, founded in 1889, was dismantled by the Soviets in 1945 and outfitted again in 1947. Since the return of Mannesmann-Trauzl to Austrian ownership on August 13, 1955, the factory has been trying to find a market for its products in the West.

From 1947 to 1955, the factory turned out 92 rotary sets for depths up to 2,500 meters (8,202.5 feet), 29 mobile drilling sets for depths up to 1,200 meters (3,937.2 feet), 7,750 roller bits, 23,318 tool joints, 244 fishing tools, and one rotary drilling rig for a depth of 4,500 meters (14,764.5 feet) was sent to East Germany and another to Hungary.

Tapline Capacity To Rise

Trans-Arabian Pipe Line Co. will install four auxiliary pumping units in Saudi Arabia and Jordan to increase throughput by approximately 90,000 b/d. The units will be auxiliary to the main pumping stations at Qaisumah, Rafha, Badanah and Turaif in Saudi Arabia. The new auxiliary pumps will be located about midway between stations, the most westerly unit being located at Qaryatain in Jordan. A fifth unit will be added to existing facilities at Turaif. The units will be unattached, and their operation will be controlled by radio from the main pumping stations.

The new pumps are scheduled to be in operation by the first of January, 1958. After the new units are placed in operation, the maximum pipe line throughput will be about 410,000 b/d. Present capacity is 320,000 b/d. The line can be raised to about 500,000 b/d.

Turkish Pipe Line To Be Completed

The Batman-Garzan oil pipe line is expected to be completed in Turkey this summer, it is reported. This would tie in with a 22.5-kilometer line of three inches from Raman oil field to Batman refinery, which has two pump stations.

The Batman refinery is partly responsible for a jump in crude oil production in Turkey last year to 178,536 metric tons (3,571 b/d).

Boats for Papua

The third of three specially designed landing craft, for the transport of drilling gear and equipment through the winding rivers of Papua to test drilling sites, has left for Papua, being towed on its 8,500 mile journey by the sea-going tug "Tradesman" which towed out the first two sister crafts. These crafts have been named "Gurubi," "Gimada" and "Geboso" after Papuan villages.

The 19,830 dwt motor-tanker "Helfrid Billner," is probably the first ship in the world to be fitted with an aerial for directed short wave transmission.

This aerial is rigged between the foremast and the radar mast amidships, both of which are higher than normal in order to give the aerial a proper elevation.

U. S. Award For Borneo Oilman

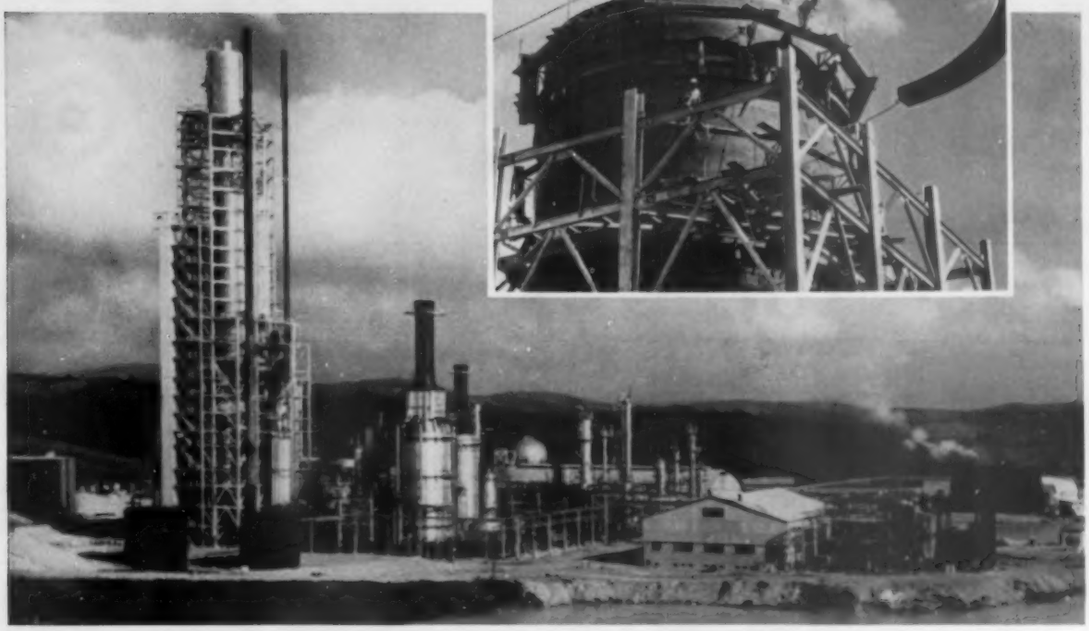
S. M. James, an Indian supervisor in The British Malayan Petroleum Co.'s welding shop at Seria, British Borneo, has become the first man outside the U. S. to receive the Meritorious Safety Award of the Associated Petroleum Institute of America.

A Dayak electrician was working in the welding shop when he contacted high-voltage overhead cables and apparently was killed outright. But Mr. James began immediate artificial respiration, and eventually the man revived and recovered—due entirely, according to doctors, to the prompt start of resuscitation measures by Mr. James.

[1] *"Electro-drilling in Tuymazy (USSR)" by K. N. Yevstigneyev, S. D. Bobko, S. Y. Tshepurnoi, from NEFTY ANOYE KHOSY AISTVO, No. 8, August 1955, p. 19.*

1 ST TYPE 120 T.C.C. UNIT

erected at Capuava Refinery by CB&I



Top: An air duct section for the TCC kiln being raised into place.

Bottom: General view of Capuava Refinery.

• Fourteen miles north of Sao Paulo, Brazil, at Capuava, a main fractionating tower and the *first* type 120 Thermofor unit to be built was erected by Chicago Bridge & Iron Company in cooperation with their subsidiary, Sociedade Chibridge de Construcoes, Ltda. Both of the units were fabricated at our Greenville, Pa. plant and furnished through Hydrocarbon Research, Inc., New York, for Refinaria e Exploracao de Petroleo "UNIAO" S.A. The UNIAO refinery has a crude capacity in excess of 20,000 bbls. per day and can handle a wide variety of stocks.

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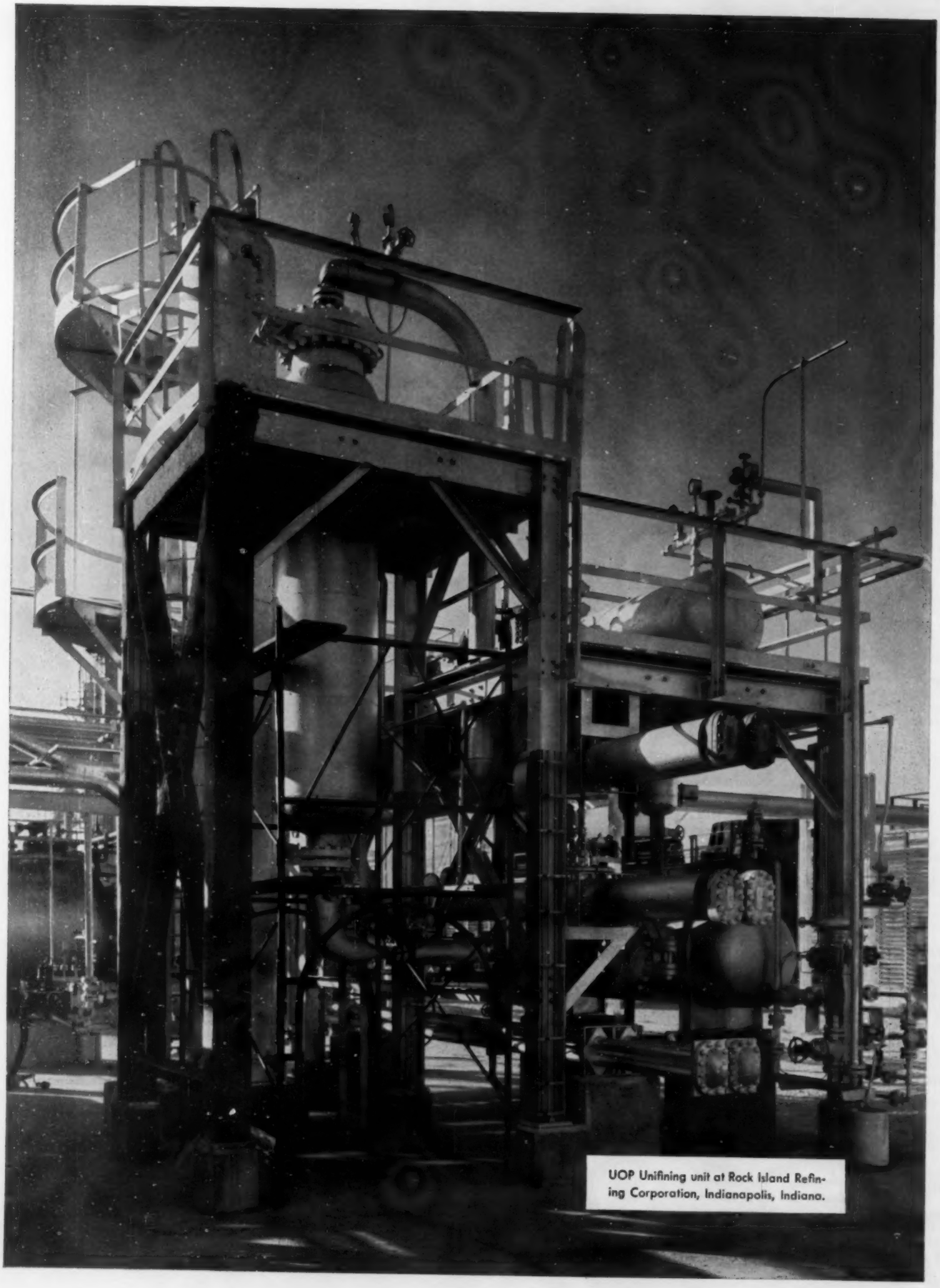

UOP Unifining unit at Rock Island Refining Corporation, Indianapolis, Indiana.

Unifining Solves Major Problem for Rock Island Refining Corporation

By L. E. Winkler
President
Rock Island Refining Corporation
Indianapolis, Indiana

Installation of a 300 barrel per stream day Unifining unit has solved a particularly knotty problem for us, and has enabled Rock Island Refining Corporation to raise the octane rating of its pool gasoline by a full number.

L. E. Winkler

Prior to the time the Unifining unit went on stream last September, our refinery had about 150 barrels a day of low quality vis-breaker gasoline which, if blended with Platformate from our UOP Platforming unit, catalytically cracked gasoline and other refinery stocks, would lower the octane number of the pool gasoline. Using it as a charging stock to the Platformer was uneconomical since the vis-breaker gasoline contained certain contaminants which are known to reduce the life of the catalyst. We were, furthermore, reluctant to make a large capital investment to improve this material, and we did not want to dispose of it as an inferior product.

Universal Oil Products Company designed and engineered the Unifining unit in such a manner that it required only a comparatively small capital investment to convert the vis-breaker gasoline into a choice stock for Platforming. Results obtained so far indicate that the unit will be amortized in about a year on the basis of tetraethyl lead savings.

The Unifining unit at our plant is considerably different from others now in operation. It operates at pressures substantially lower than those normally recommended for processing olefinic stocks; there are no compressors because the low operating pressure made it possible to design the unit to use excess hydrogen from the Platformer without recompression; there are no fired heaters since hot effluent from the Platformer serves to provide a portion of the heat required to maintain the Unifining reaction, and electronic instruments control the unit.

The total make of vis-breaker gasoline is charged to the unit in admixture with enough straight run gasoline to control the heat of reaction. The mixed stream picks up the required amount of hydrogen for the reaction and enters a heat exchanger to be preheated while the reactor effluent is being cooled. The balance of the required preheat is obtained by heat exchange against the reactor effluent from the Platformer. The hot charge flows over the Hydrobon catalyst, which is of the cobalt and molybdenum type, and reactor effluent is heat exchanged against incoming charge and cooled with water before entering a high pressure separator. Any unreacted hydrogen goes to fuel gas. The treated product is further reduced in pressure, then is mixed with the rest of the charge to the Platforming unit.

After Unifining, the total sulfur was reduced to 0.008 weight per cent from an original content of 0.143 per cent. Basic nitrogen has been lowered to less than one part per million when formerly it was 2.7. Arsenic has dropped from 120 parts per billion to less than one part. Only a trace of olefins remains in the product, whereas the charge contained 16 volume per cent. Paraffins have increased from 46 to 58 volume per cent. Naphthenes now are 37 volume per cent against 31 in the charge. Virtually no change is shown in ASTM distillation.

The electronic controls were chosen because we have received good service from similar instruments on the Platformer. This instrumentation was a factor in lining out the Unifining unit when it was placed on stream. Specification product was being produced within four hours after the startup. The controls were comparatively easy to install because of the experience we had on the Platforming unit. They are giving virtually trouble-free service.

Because of Universal's recommendation to install a Unifining unit, we now are converting a normally low quality product which we could not use profitably into a charging stock that is ideally suited for processing in our Platforming unit. Universal furnished the design and process engineering for the Unifining unit, which was built by refinery personnel.

INDIANA REFINER RAISES OCTANE RATING OF POOL GASOLINE BY INSTALLING UNIFINING UNIT

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Forty Years Of Leadership In Petroleum Refining Technology

International News and Notes

Romania Offers Oil Settlement

Romania has offered to negotiate a settlement of United States claims for war damages and for property she nationalized on June 11, 1948, without compensation. Total United States claims against Romania have been estimated at approximately $88.5 million, based largely on war damage, nationalization and land confiscation claims for which Romania is held responsible under the Peace Treaty (signed Feb. 10, 1947, in Paris) and the rules of international law.

The distribution of capital by nationalities on Aug. 1, 1945, was as follows:

Nationality	*Per Cent of Capital*
Romanian	27.34
British	22.51
Soviet (ex-German)	12.53
American	12.30
French	10.65
Italian	3.80
Belgian	3.42
Dutch	1.63
Other	5.82

Czechoslovakia Misses Production Target

Official statistics in Prague state oil production in 1955 was under the target levels. 1954 production was about 3,822 b/d; last year's production was about 4,109 b/d.

In 1954, 72.3% of Czechoslovakia's crude oil imports were supplied by the Soviet Union.

Intensified development of the gas reserves in western Slovakia and southeastern Moravia was announced.

In 1956 a 49.7 mile gas line is to be laid from Trnava (southwest Slovakia) to Nove Mesta, Vah, Trencin and Dubnica. This pipe line is later to be extended to Zilina and Trzynietz near Tesin. Branch lines are planned to Nitra, Prievidza and Ziar. The industrial area around Brno (Moravia) is also to be supplied with gas.

Russia's Five-Year Plan

Under the Sixth Five-Year Plan (1956-1960), approximately 5,589 miles of main gas pipelines are to be built.

The Soviet Union plans to construct 9,004.5 miles of main oil pipe lines during 1956-1960. They are: Tuymaya-Omsk (the second) Omsk-Irkutsk, Almetievsk-Gorky, Almetievsk-Molotiv, Gorky-Ryazan, Ryazan-Moscow, Gorky-Yaroslavl, Ishimbai-Orsk, Omsk-Novosibirsk, Ufa-Omsk (the second), Novosibirsk-Iikutsk, Kuybyshev-Bryansk, Omsk-Pavlodar.

Within the next five years, the planned crude production increase over 1955 is as follows: in the Russian Federative Socialist Republic, 2.2 times; the Ukrainian SSR, 2.8 times; in the Kazakh SSR, 1.4 times; in the Turkmen SSR, 1.3 times; in the Estonian SSR (oil shale), 1.7 times; in the Kirghiz SSR, 7.9 times; and in Azerbaidjan SSR, 15.7 million m/tons for 1960.

By 1960, refineries are planned as follows: in Kazakh SSR, 2; in Ukrainian SSR, 1; in Byellorussian SSR, 2; in Estonian SSR, a shale oil refinery; in Uzbek SSR the Fergana refinery is to be put into operation.

In the Turkmen SSR the capacity of the Krasnovodsk refinery is to be increased to process all oil produced in the Republic. In the Russian Federative Socialist Republic, the Omsk refinery, put into partial operation in 1955, is to be completed.

In 1960, 75% of the country's oil is to come from the Volga-Urals regions (see table below) where production cost is 3 to 4 times lower than in the old oil-producing areas. But also the old fields such as Baku and Grozny, from which the better grades of oil come, will be developed.

Geographical Distribution of Oil Production

	1940	*1950*	*1952*	*1960 (Plan)*
Eastern oil area, particularly Volga-Urals region, "Second Baku"	12%	44%	52%	75%
Western oil area, particularly Baku, Grozny, Maikop	88%	56%	48%	25%

The planners revealed that oil extraction in the Kazakh SSR did not increase during the past few years and that known oil deposits are decreasing. The Georgian SSR is said to have invested millions of rubles in exploration during the past 20 years in prospecting and producing of oil, with little result compared with investments.

ENI Oil Loan

Ente Nazionale Idrocarburi, the state oil organization, has been granted authority by the Italian government to raise a loan of 60,000m. lire ($95 million) spread over three years in equal installments. This will be used to finance a project at Ravenna for the manufacture of fertilizers and synthetic rubber from natural gas and for oil exploration in southern and central Italy.

Austrian Drilling, Crude Shipments Rise

The Austrian Mineral Oil Administration has plans to drill about 90 production wells—mostly in the Matzen, Auersthal, and Bockfliess areas—and 12 to 14 exploratory wells during 1956. The planned pipe line from the Bockfliess field to the Korneuburg refinery is to be finished during 1956.

Recently Austria has announced an increase in the rate of oil payments to Russia. Under the Peace Treaty of 1955, Austria is obligated to deliver about 21,479 b/d of crude over the next ten years to Russia. This is payable at the rate of 23,014 b/d in the first six years and 19,178 b/d in the last four. There is also a payment of about $150 million to be made, mostly in goods of which oil forms a part. The new announcement stated that payments would be made at the rate of about 26,000 b/d, which would enable the obligation to be paid off in less than the anticipated 10 years.

Changes At Seria

"Kees" Hoekendyk, drilling superintendent at Seria since 1953, will be leaving The British Malayan Petroleum Co. on retirement early in July after nearly 29 years' overseas service with The Shell Group.

J. P. Uitentuis, drilling superintendent at the Shell/D'Arcy project in Nigeria will replace Mr. Hoekendyk at Seria.

Cornelis Hoekendyk was born in December, 1906 at Rotterdam. He joined the Shell Group in 1927. He was caught by the Jap invasion of Java and was interned from 1942 to 1945. His postwar appointments included two years' service in Dutch New Guinea and tool-pushing in Nigeria and Trinidad, followed by appointment as U.B.O.T.'s drilling superintendent in 1953. He went to Seria as drilling superintendent in late 1953.

C. H. ("Vince") Vincent, senior drilling foreman, retired in April after 11 years in Borneo. His successor has not yet been named. He was born into the oil industry at Albany, Kentucky. He joined Burmah Oil in 1924, and the Shell Group in December 1945. Immediately thereafter he was sent to Seria as a tool-pusher. He took over as senior drilling foreman late in 1946.

Borneo Production, Drilling Up

About 115,166 b/d was produced in April from British Malayan Petroleum Co.'s field at Seria, State of Brunei. This was another slight increase, a trend maintained each month this year.

Sarawak Oilfields Ltd.'s diminishing field at Miri, Northern Sarawak, produced about 1,418 b/d in April, another slight but maintained increase.

Starting on May 1, British Malayan began the launching of a large deep-sea drilling platform at Ampa Patches, a coral formation in the South China Sea about 25 miles off the coast of Brunei, and about 30 miles from the existing Seria field. The platform, which is expected to spud in about September, will be serviced by helicopter and will carry enough drilling supplies for the completion of an entire well at a time—a necessary precaution because the South China Sea is subject to sudden storms, making boat connection with the platform uncertain. A crew of 32 will live aboard the platform in air-conditioned quarters, being relieved by eight-seater helicopters every eight days.

Sarawak Oilfields Ltd. is to launch a similar platform at Siwa, eighteen miles from Miri field and eight miles out at sea, early in June.

Both projects represent a considerable expansion of the Shell associates' marine drilling activities, which hitherto have been confined to four marine platforms at Seria, none more than a mile offshore.

Petroleum In Romania's Five-Year Plan

The Second Five-Year Plan (1956-1960) in Romania provides for a 28% increase in crude production from 10,575,000 metric tons in 1955 (about 211,400 b/d) to 13.5 millions m/tons (about 270,000 b/d) in 1960.

Pipe line capacity is to be raised by 5 million m/tons (about 100,000 b/d), with 1,242 miles of new line. Gas production is to increase by 260%, to 353.1 billion cubic feet in 1960. Cracking capacity is to be increased by about 70%.

In this Second Five-Year Plan, the largest portion of industrial investment (20.5%) will go to the petroleum industry. Natural gas will receive an additional 5%.

Wildcat In Portugal

Mobil Exploration Portugal, Inc., a wholly-owned subsidiary of Mobil Overseas Oil Co., Inc., operating under an agreement with Companhia dos Petroles de Portugal, has abandoned its second well, Arruda No. 1, located north of the town of Vila France de Xira, some 48 kilometers north of Lisbon. Drilling was stopped on March 20 at a total depth of 7,009 feet.

The first well, Pinhal Novo No. 1, located south of the Tejo River, was abandoned in rock salt at a depth of 5,531 feet on August 5. The company is now setting up a new 12,000-foot capacity rig at Barreiro No. 1 location, 10 kilometers outside Lisbon just south of the Tejo River, and expects to spud the well within the next few days.

1955 Drilling In Egypt

A total of 23 wells were sunk in Egypt during 1955, according to reports reaching official Washington channels.

Of these, 10 were in the Red Sea district, according to reports from Shell Oil Co. of Egypt; 12 were in the Sinai District according to reports from National Petroleum Co. of Egypt; and one was in the western district, according to reports from the Sahara Petroleum Co., formerly the Egyptian Petroleum Co.

Promising Find in Iraq

A report from Baghdad states that a new oil structure has been discovered at Rashi in the Basrah Petroleum Co.'s area 40 miles west of the Zubair oilfield and that a preliminary survey has indicated that Rashi may prove the most productive of the fields in southern Iraq. Drilling is planned during 1956.

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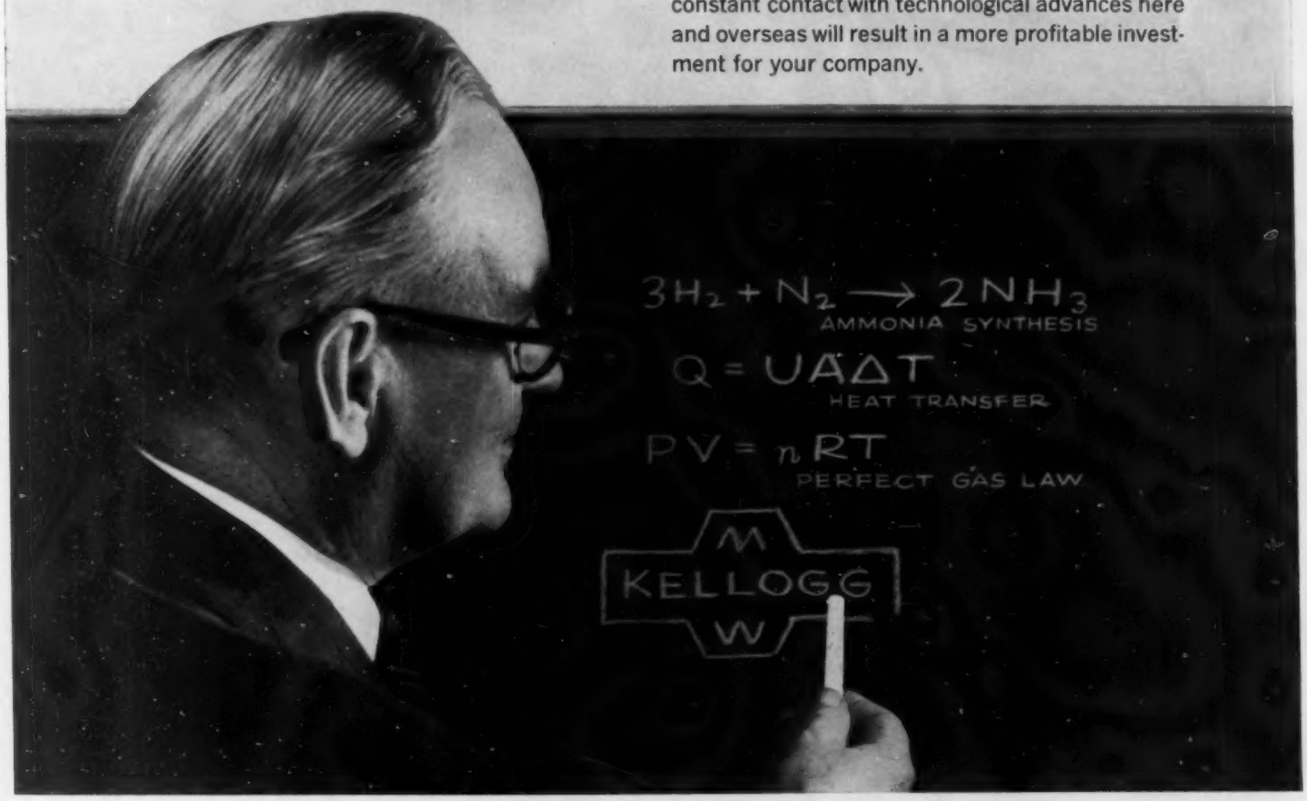

REFINERY PROCESS DIVISION

THE M. W. KELLOGG COMPANY

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M KELLOGG W

INDONESIA comprises the largest group of islands in the world, stretching out along the equator for more than three thousand miles . . . Java, home of the nation's capital, Djakarta, with 54 million of Indonesia's 80 million citizens, is about the same size as New York State. Sumatera, Kalimantan (Borneo), Bali, Sulawesi (Celebes)—these and other exotic islands of the group have a combined land area of about 735,000 square miles. Indonesia's modern economic history goes back to the 15th and 16th centuries, when Portuguese and Dutch traders began developing the spice trade and the "fabulous wealth of the Indies." An independent, democratic republic since August 17, 1945—and the world's third richest country in known natural resources—Indonesia is today spending millions of dollars to modernize and expand its industry, agriculture, and transportation, at the same time increasing its world exports of rubber, petroleum products, tin ore, copra, tea, tobacco, palm oil, coffee, pepper, and sugar.

Standard-Vacuum's part in the development of Indonesia's petroleum industry covers a wide range of operations from geophysical exploration and production through transportation, refining, and marketing of petroleum products. Ninety-six per cent of Stanvac's 14,000 employees in this area are Indonesian nationals.

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SOUTH PACIFIC ISLANDS • SOUTH WEST AFRICA • TANGANYIKA • THAILAND • UNION OF SOUTH AFRICA • VIETNAM

Eastern Hemisphere Review

Europe

Total energy requirements of Western Europe are expected to increase about 70% during the next 20 years, according to the Coal Committee of the OEEC. Consumption increases during 1956 will be about 13%, according to industry sources. Eastern Hemisphere will average 10%, compared with an expected 4.5% increase in the U.S.

Austria—A concession for exploration has been granted to the Gesellschaft fur Erforschung und Gewinnung von Bodenschaetzen, a local company. Area covered is near the town of Feldkirch in Vorarlberg province of western Austria near the Swiss border. Duration of the concession is 5 years. Royalty is 12% on sales value of oil found, 9% on gas sales. Above 6,000 b/d, royalty increases 1% for each additional 2,000 b/d up to 30% maximum on sales value.

Oil shows have been announced by RAG, owned equally by Shell and Socony Mobil companies. Location is near Puchkirchen in upper Austria. This is outside the restricted area, where the Russians prohibit foreign operations. The well, Puchkirchen 1, hit basement at 8,500 feet and found a 6-foot pay section at 7,750 feet. A thicker section is expected in offset wells. Production was 250 b/d of 34° API crude.

Payments of oil to Russia have caused a 45% curtailment of fuel oil deliveries to Austrian consumers. Crude payments were recently increased to about 26,000 b/d and Austrian production is not sufficient to meet local, plus reparations, demand for fuel oil.

Belgium—Crude runs to stills were 10,299,000 barrels in the first quarter of 1956, up 45% from the first quarter of 1955. Consumption was 9,900,000 barrels, up 25%; imports were 4,605,000 barrels, up 6%; exports were 4,834,000 barrels, up 54%.

Cyprus—Forest Oil, a U.S. company, has received exploration rights on the entire island, with the exception of one square mile held by a local operator. An exploratory well is planned during 1956.

France—Essorep, operator of the Parentis field, has given up half its original exploration permit area. About 2.2 million acres are being retained, on which the expiration date has been extended to Feb. 20, 1961.

Four companies, Pechiney, Saint-Gobain, Pierrefitte-Kalaa-Djerda and l'Office National Industriel de l'Azote, will build petrochemical plants in France. The plants are to be located in southern France and will operate on Lacq gas, production of which will begin during Jan., 1957.

The Neyrpic company, makers of a turbodrill, have signed a contract with Hughes Tool Company of the U.S. for development of special rock bits for turbo drilling. Hughes' German licensee, Alfred Wirth & Co., will manufacture and service the Neyrpic turbo-drill in Germany.

Crude reserves are given by a French official at 210 million barrels, which compares with about 120 million estimate of proved reserves by U.S. sources. The same official, who is Secretary of State for Commerce and Industry, stressed French need of oil development to fill an estimated 50-million-tons energy deficit by 1960, expressed in coal equivalent.

Germany—Product exports during the first quarter of 1956 were 293,297 metric tons (24,444 b/d). This is 27.7% over the previous quarter and 47.6% over the same quarter in 1955.

Greece—Product imports during 1955 were up 7.3% over 1954 levels. Total for the year was 1,511,572 metric tons (about 30,231 b/d), of which Diesel, light and heavy fuel oils were 1,093,812 tons, gasoline was 303,467 tons, kerosine was 95,232 tons and lubes and greases 19,053 tons. Of imports, 52.53% originated in Italy, followed by 9.82% from Iran, 9% from Rumania.

Italy—Foreign investment in the petroleum industry totaled about $38 million at the end of 1954, representing about one-third of total petroleum investment. Largest amount was invested in refineries. Leading companies were Jersey Standard, Caltex, Socony, Gulf and British Petroleum.

A new law governing oil exploration on the continental shelf is under consideration.

Norway—A/S Norske Esso, owned 56% by Jersey Standard, is negotiating for the construction of a refinery at Skjebergkilen, 50 miles south of Oslo. Capacity, cost and other details are not settled yet.

Spain—Refining capacity is to reach 120,000 b/d by 1960, according to reports, up from about 70,000 b/d at present. Cia. Espanola de Petroleos will raise runs by 8,400 b/d in 1956 to 36,500 b/d.

Middle East

Abu Dhabi—The Gezira wildcat has been abandoned dry by IPC's subsidiary at 12,500 feet.

Aden—Additions to the refinery will add one thermal reformer to improve gasoline octane ratings, add tankage and increase product diversification. Bechtel & Wimpley will handle the additions. 1955 production was about at the 100,000 b/d capacity with 46,000 b/d fuel oil, 20,000 b/d gas and Diesel oil, 18,000 b/d motor gasoline, 6,000 b/d kerosine, 2,000 b/d aviation turbine fuel and 1,900 b/d vaporizing oil.

Iran—Oil revenues in 1956 are estimated at $145 million, an increase of $55 million over 1955. Revenue in 1954 was $8.5 million. About $12 million results from an increase over levels agreed upon in the Consortium agreement of 1954. An additional $54 million will accrue to Iran in 1956 through oil salaries and expenditures.

Despite the recent Consortium agreement to raise production by 10% to 27.5 million tons (about 550,000 b/d), a four billion rial (about $16.9 billion) deficit is expected on the 1957 budget. Over half the deficit will be covered by U.S. aid.

A government spokesman stated that U.S. and Swiss geologists have found "heavy oil deposits" in Iran, near the Soviet border.

Iraq—An agreement with Iran will be signed shortly for a unified oil policy, according to Nadim Pachachi, Minister of Economy.

Estimates of oil revenue during the five-year period 1960-1965 have been revised upward, with concurrent increases in the development plan for that period. Plan income is now estimated at $1.16 billion, up 37.3%. Since the Plan receives 70% of oil income, this would put total oil receipts at $1.66 billion.

Bids for expansion of the government's Daura refinery from 24,000 to 30,000 b/d in 1957 and 40,000 b/d in 1960 reportedly will be accepted soon.

An oil find has been made by Mosul Petroleum in the Sassan area, 25 miles southwest of the Ain Zalah field. Production is from 5,300-5,500 feet, 39° API gravity oil.

Jordan—A 4,300 b/d refinery is under consideration. Local capital has subscribed $2.1 million; the government will supply the remainder of the estimated $11.3 million cost. Location will be El-Zarka, 15 miles from Ammam. IPC and Tapline will supply crude. Capacity is later to be raised to 6,600 b/d.

Neutral Zone—Pacific Western has changed its name to Getty Oil Co. The company has a concession on the Saudi Arabian half of the Zone.

Crude production is to be increased to about 100,000 b/d by the end of 1956 under an expanded drilling program now in progress. This will go to partially supply European demand and part of Tidewater Oil's new 130,000 b/d refinery at Delaware City, now nearing completion, in which Paul Getty, owner of Getty Oil, has an interest.

Saudi Arabia—Four new gas turbine pumping units will be installed on Tapline. They will increase throughput by 90,000 b/d to 410,000 b/d. Tapline runs from Qatif in Saudi Arabia to Sidon, Lebanon. The line can be expanded to 500,000 b/d.

Syria—Fourth-quarter pipeline deliveries were 483,001 b/d in 1955, up very slightly from 479,939 b/d in the same period a year earlier. Deliveries to ships and refineries in the same period were 499,032 b/d and 323,465 b/d respectively.

Lebanon, Syria and Jordan have agreed on Tapline's proposal to set up a profit-making company to manage the pipeline and split profits 50-50. Profits are to be figured on the difference between crude selling price on the Mediterranean and the Persian Gulf, presently about 49 cents per barrel. This would give about $16 million to be divided among the three countries and Saudia Arabia. Negotiations with the latter are going forward at present. The main difficulty is a method of division between countries involved. Profits will rise to about $25 million in 1958 with increased Tapline capacity.

Turkey—The government has authorized a $10 million refinery to be built at Izmit on the Sea of Marmora, near Istanbul. Applicants were Dr. C. Birtek and Masip Fesci. $4 million capital will come from Wm. Blair & Co. of Chicago, $6 million from a Chicago bank.

An application by F. St. Hilaire of Los Angeles and others to build a 15,000 b/d refinery has been approved by the government. Completion date is set for 1958, the contractor has not been selected as yet.

Africa

Algeria—The oil discovery by CREPS company may be in Libya, instead of Algeria. Some of the companies having adjoining concessions in Libya are involved in heated discussion with the French government concerning the extent of their holdings.

Oil shows have been reported by the government's BRP in the Reggan area. Depth was 984 feet in carboniferous sandstone. Location was at Reggan, an oasis at 26°42'N, 0°11'E, about 90 miles south-southeast of Adar.

Eygpt—Dr. Abu Zeid, former head of the Fuel Department, is leaving the government to go with the Petroleum Cooperative Society. The latter is a marketing organization which works closely with the government in refining activities. Abu Zeid will sit on the policy-making body of the government's Supreme Oil Authority, headed by Co. Youness.

Independents applying for acreage have been offered increased royalty and government participation in development. Among the American companies interested are Tidewater, General American Oil, Socony, Shell, Sahara Petroleum, Ralph E. Fair, Inc., and American Near East Associates. Egyptian companies include Cooperative Petroleum Soc. of Egypt, African Oilfields Ltd. and Egyptian Oil and Gas Corp.

Libya—W. R. Grace & Co. has joined Texas Gulf Producing in exploration in Libya through Libya American Oil Co. A well is being drilled, the first in Libya, in the Gerdes El Abid section of Cyrenaica.

Morocco—A drilling company, Forenco, has been formed by the only producing company in Morocco, Ste. Cherifienne des Petroles, with the Banque de Paris et des Pays Bas. Initial capital is $1.8 million.

Mozambique—Petroleum product imports averaged 1,573 b/d during 1954, the latest statistics available on this area.

Asia and Australia

Australia—Domestic oil demand rose 19% in 1955. Fuel oil rose 39%, gasoline rose 8.9%, power kerosine was stationary. Local refining met 66% of domestic demand, compared with 31% in 1954. Oil imports were up 33⅓% to about 160,000 b/d, of which about 100,000 b/d was crude.

British Borneo—British Malayan Co. has launched an offshore drilling platform at Ampa Patches, about 30 miles from Seria and 25 miles offshore. Drilling is to begin during September. Sarawak Oilfields will have a similar platform in June at Siwa, 18 miles from the Miri field.

China—An oil discovery is reported in the Ozungaria basin of north Sinkiang province.

Pakistan—A depletion allowance of 15% gross up to 50% net income has been made part of the tax law. Deduction of exploratory and drilling costs is also allowed.

Shell has received concessions for exploration of about 20,000 square miles in East and West Pakistan. The Pakistan law calls for up to 30% participation by Pakistani capital; Shell gave 25% participation to private citizens, with no government share.

THREE MEN AND A BUOY

in Search of Oil

The men are Cities Service geologists, the buoy a marker used in undersea oil exploration.

That this search involves great expense, everyone agrees. That it will prove successful, no one can guarantee—since the odds for exploratory drilling are nine to one against a discovery. The Cities Service oil seekers, however, continue to chalk up impressive records in both land and sea exploration. Records such as 1955's one-out-of-three success ratio for test wells ...far above the ratio for the oil industry.

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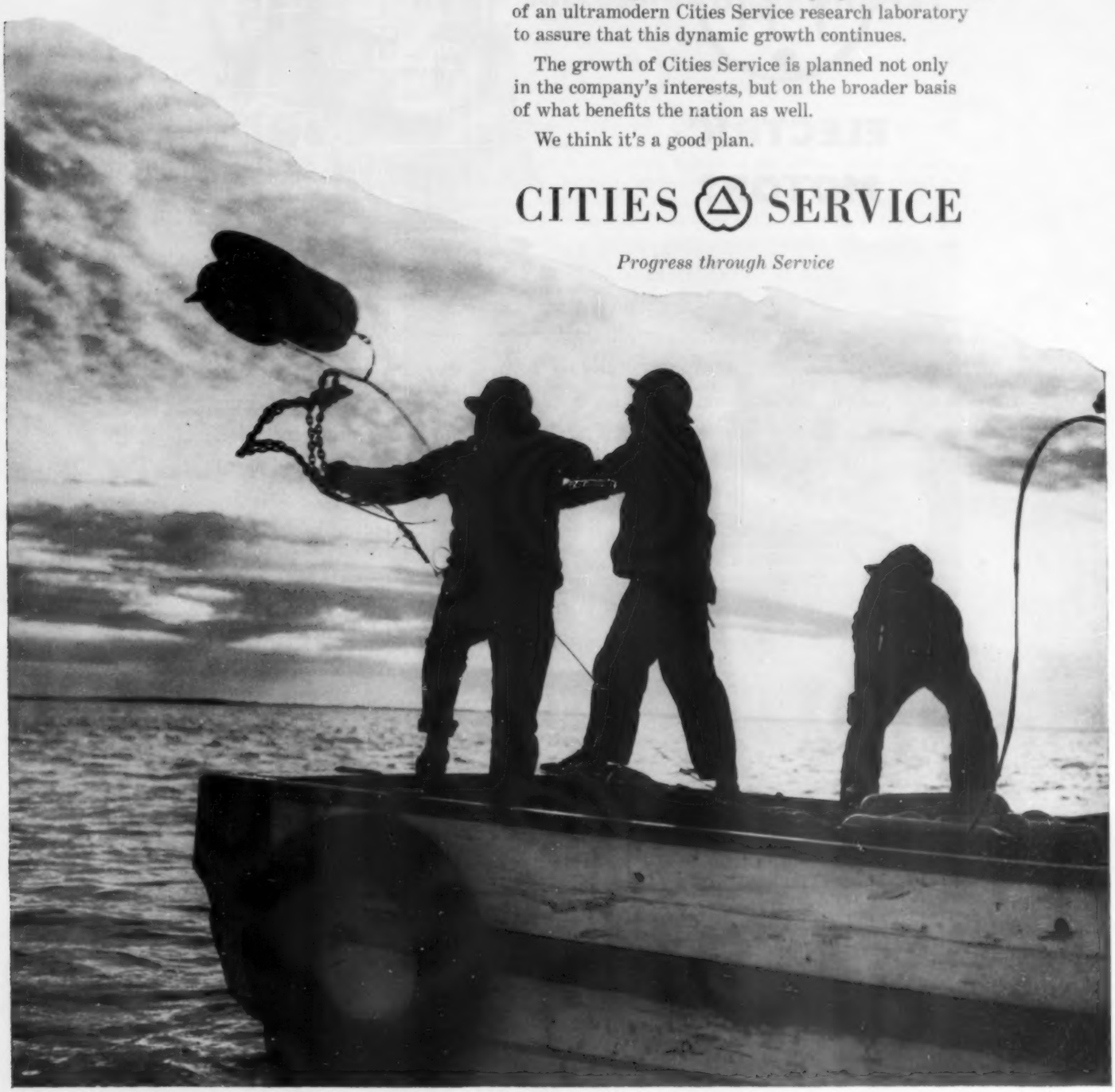

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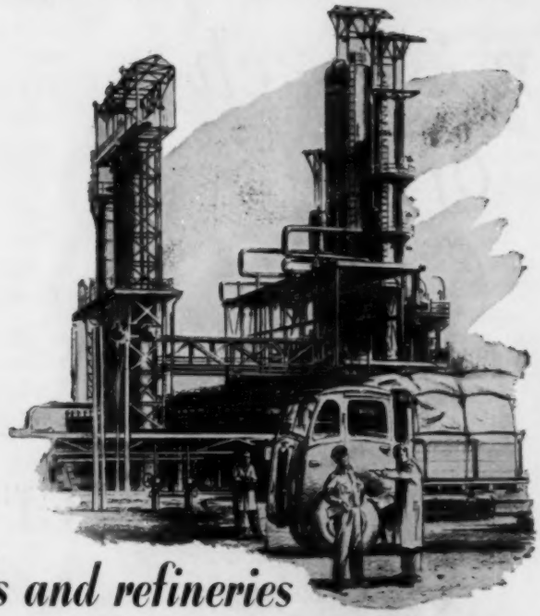

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DU PONT

PETROLEUM CHEMICALS DIVISION NEWS

DU PONT

July ★ One of a Series of Bulletins for the Petroleum Industry ★ 1956

Question Box

1. HOW can you persuade your dealers to try for increased sales volume on the basis of good management practices?
   The article at the right may give you some ideas.
2. HOW can you insure stability of distillate fuel oils?
   See below for answer and other important information concerning effective additives.
3. WHO can help you with your fuel oil stability problems?
   You can read on the next page about one of many Du Pont specialists in this field.

Need continues for additives in all types of fuel oils

The market for fuel oils is becoming more complex as the result of a demand for petroleum products tailored to specific consumer needs.

To accomplish this tailoring job, chemical additives generally offer you the easiest and most economical means . . . particularly where stability and blending compatibility problems are involved. This is true of furnace oils, diesel fuels, and residual fuels.

The various aspects of tailoring these different types of fuel oils to consumer demands through the use of additives were recently discussed in a paper by William deB. Bertolette and John D. Rogers of the Du Pont Petroleum Laboratory, presented before the Western Petroleum Refiners' Association.

Du Pont Fuel Oil Additive No. 2 (FOA-2) is ideally suited for stabilizing these fuel oils because it is an *ashless* polymeric additive. This means that it does not leave a metallic deposit or alter the chemical characteristics of the deposits that are formed.

Stabilizer and dispersant

Du Pont FOA-2 not only stabilizes the fuel to prevent sludge formation, but it also helps to rid dirty systems of any sludge that may have previously formed.

If you would like more information on Du Pont FOA-2 or a copy of the W.P.R.A. paper entitled "Improving Fuel Oils through the Use of Additives," just send your request to any of our sales offices listed on the next page.

Why are some dealers more successful than others?

The latest report — No. 5 in the Du Pont Service Station Operator Survey — reveals many controllable factors bearing on this question.

"Stay open long hours . . . advertise . . . carry a complete line of tires, batteries and accessories!"

These three practices are common to *most* of the stations which are *most* successful. There are, however, many more ingredients of success revealed in Du Pont's Service Station Operator Survey, Report No. 5, just published.

Marketing men in the industry of course are well aware of the factors which make a service station successful.

However, the highly interesting statistics developed through the survey may help them determine the degree to which each factor contributes to success, and may go far toward helping them convince dealers.

Most significant

This is the final and most significant report of the 5-part series. It discusses the *interrelationship* of various factors affecting service station operation. It may also interest you to know that in preparing this report, the results were sorted, weighed and correlated by the Univac electronic computer.

The survey data, however, should not be interpreted to show cause-and-effect relationships. And no single one of the factors analyzed, of and by itself, can guarantee success. Too, some of the variables may be considered beyond the station operator's control.

Successful stations

Yet, the report shows clearly that there is a marked difference between successful and unsuccessful stations. What's more, most of the variables considered in this report are of such a nature that

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OVER

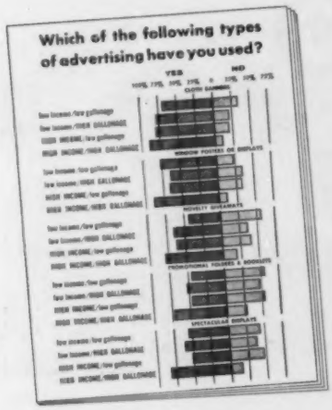
PETROLEUM CHEMICALS DIVISION
NEWS

CONTINUED *Dealer Success*

the service station operator has, within his power, the means for reducing any differences between his station and stations that are outstandingly more successful.

In practical terms, this means that of any representative cross-sectional group of stations, some can usually be said to be enjoying a higher income than the average if an established set of conditions is met:

1. Stay open longer.
2. Do more advertising.
3. Offer complete services.
4. Managed by operator with long experience in charge of station.
5. Managed by operator active in community projects and organizations.
6. Owner-operated.
7. Are neat.
8. Managed by better educated operator.
9. Sell TBA.
10. Price of regular gasoline thought by dealer to be lower than in his vicinity.



HERE IS a typical page from Report No. 5 on the Du Pont Service Station Operator Survey. It shows that over 40% of the high-income/high-gallonage stations spend more than $200 annually for off-station advertising. On the other hand, only 6.8% of the low-income/low-gallonage stations spend more than $200 annually for off-station advertising.

Continued middle next column

AT DU PONT PETROLEUM LABORATORY

WILLIAM deB. BERTOLETTE is Technical Service Supervisor of the Fuel Oil Group at the Du Pont Petroleum Laboratory.

He joined the Du Pont Company in 1936 after graduating from Pennsylvania State University with a B.S. degree in chemical engineering. His first assignment was at the company's Jackson Laboratory, where he did analytical work on dyes and other organic chemicals. He was then transferred to the Chambers Works where he became a chemist in the TEL area.

From 1938 to 1946, Mr. Bertolette was stationed at the Baton Rouge plant. There he was in charge of chemical control work, and later became a TEL Production Supervisor. He was transferred to production control work in Wilmington in 1946. In 1950 he joined the Technical Section.

He assumed his present position at the Petroleum Laboratory in 1955. Mr. Bertolette is a member of the American Institute of Chemical Engineers and of the Petroleum Division of the American Chemical Society.

WILLIAM deB. BERTOLETTE

Relative importance studied

Although no absolute dollar values can be assigned to the success-factors, we were able, with the help of the Univac, to analyze their importance relative to the over-all success of a number of stations in the survey sample. You will probably find the bar charts presenting these data among the most interesting and valuable parts of this Survey Report No. 5.

The report also discusses each of the factors individually . . . with the supporting evidence clearly presented in the easy-to-follow bar chart form.

Survey entirely objective

Sponsored by Du Pont, the survey was conducted on a completely impartial basis by National Analysts, Inc. It was nationwide in scope and a part of the continuing market research work conducted by the Du Pont Petroleum Chemicals Division. It follows logically the recent Du Pont survey of service station customer buying habits.

Using the scientifically accurate area sampling method, the survey consisted of personal interviews with 2,633 service station operators. This sample is representative of all the operators in the United States.

Available to marketers

The findings of this report, like the findings of the four which preceded it, are available to all oil companies.

For more information about this survey, just get in touch with one of our representatives at the nearest sales office listed below.

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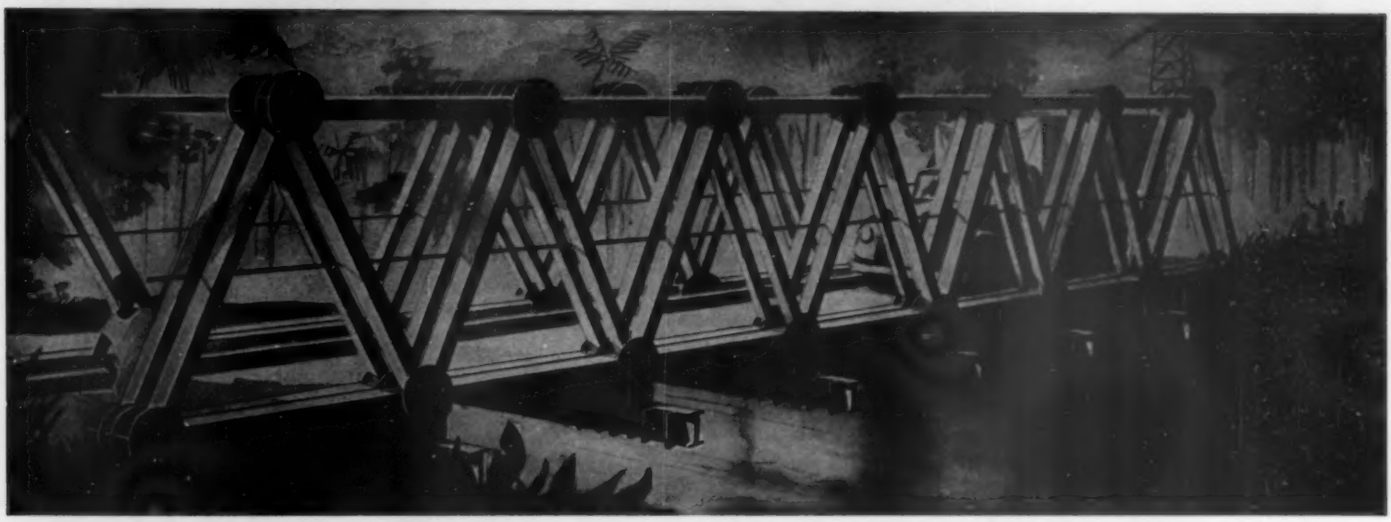
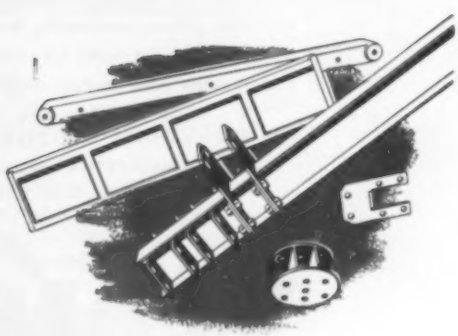


remote up-country sites

Butterley Standard-Unit Bridges are in use all over the world where transport is difficult, skilled labour scarce or where site preparation has to be carried out under adverse conditions. From five standard units, all sizes of bridges can be built; the units can be sent by any form of transport; site erection is remarkably simple and swift with an absolute minimum of equipment.



THE BUTTERLEY STANDARD-UNIT BRIDGE

THE BUTTERLEY COMPANY LIMITED RIPLEY DERBY ENGLAND

London Office: 9 UPPER BELGRAVE STREET S.W.1.

On location for Durham Drilling Co., West Texas—this Super 7-11 rig has three LRZBU Waukesha Gas Power Units.

WAUKESHA powers this IDECO Super 7-11

1250 hp input (nominal) — for low-cost drilling to 12000-ft. with 4½-in. pipe

SUPER POWER for this Super 7-11 rig! Three Waukesha LRZBU Big Gas Units, each capable of 550 max. hp at 1200 rpm—transmit power smoothly through disconnecting fluid couplings to the sectionalized compound. Chain and gear transmission, with six forward and two reverse speeds to the main drum and three forward and one reverse to the catheads, rotary and sand line drum, give a range of speed and torque to meet all drilling conditions. Completely air controlled. The Waukesha LRZBU—6-cyl., 9⅜-in. x 8½-in., 3520 cu. in.—has a 7-bearing 5½-in. counterbalanced crankshaft and aluminum pistons; renewable, wet cylinder sleeves; Stellite-faced exhaust valves with Stellite seats; full pressure oiling; precision bearings; full flow oil cooler; many other modern design features; all described in Bulletin 1481.

WAUKESHA MOTOR COMPANY
WAUKESHA, WISCONSIN
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WAUKESHA

285

SECURITY QUALITY SHOWS...
after drilling two miles in Arbuckle lime!

Drilling for Frankfort Oil Company near Ardmore, Oklahoma, Riceland Corporation opened 11,616 feet of hole in solid Arbuckle lime — a record depth in this hard rock formation. After comparing performance of the two biggest selling brands of rock bits used exclusively on this location, Riceland Toolpusher Page Arnall said:

"When bits were pulled, Security dulls looked better. Cones and bearings stood up better under this hard drilling — more insurance against fishing jobs."

To look better after coming out of the hole means this: Security bits *were* better before going into the hole. Better engineered . . . better designed . . . better built. Results on this, and hundreds of other locations, prove it! Here, each Security bit averaged four feet of hole more than competitive bits used — 53.7 feet compared with 49.7 feet.

Constantly alert for ways to cut costs, progressive contractors everywhere are switching to Security. Try Security rock bits on *your* next location. Prove to yourself that drilling costs drop when you *get Security in your drilling!*

Security
ENGINEERING DIVISION

Plants: Dallas, Texas • Whittier, California
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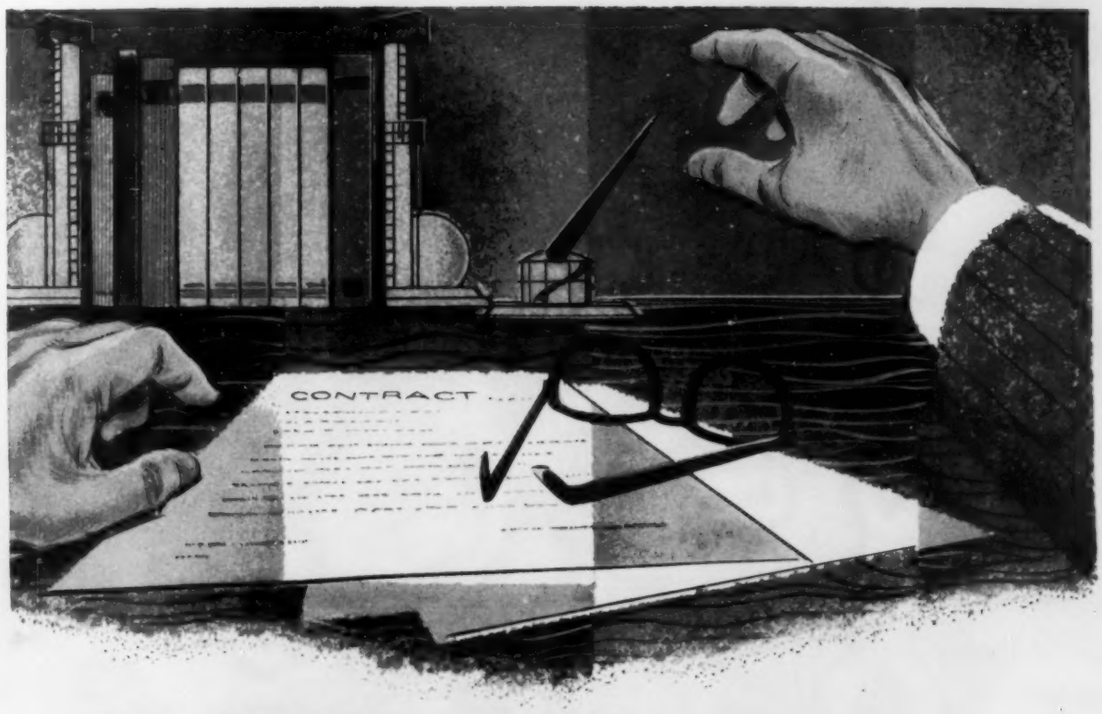
Write for 1956-1957 Catalog.

ROCK BITS • REAMERS • CASING SCRAPERS • RUBBER STABILIZERS



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All too frequently your need for a turnaround isn't revealed until there's an operational failure. Yet it is so easy to avoid the excessive costs and inconvenience of sudden, unplanned shut-downs.

Simply contract with Procon for a schedule of turnaround maintenance. Then your downtime can be economically planned in advance and one of Procon's experienced turnaround crews will overhaul your unit expertly and get it back on stream in the shortest possible time.

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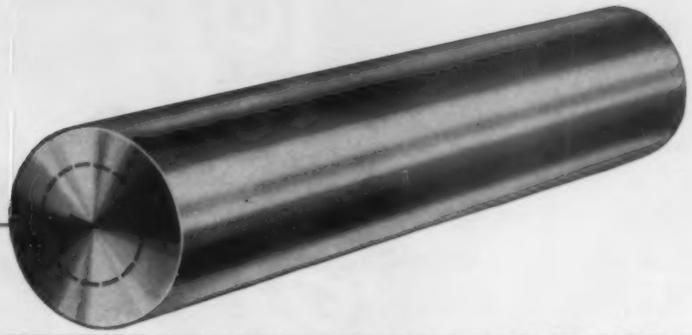
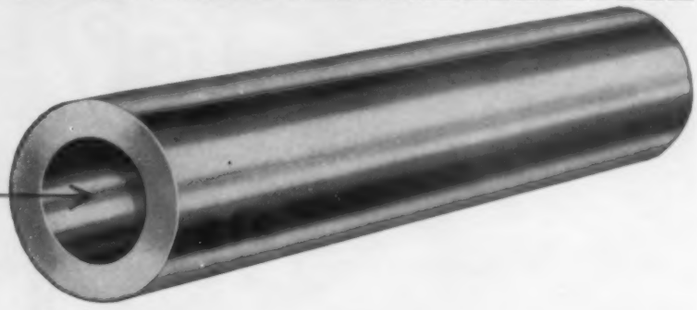
Why pay for all this steel





When you can start with this?

Buy TIMKEN® seamless steel tubing

If you're making hollow parts, and bore cut *solid* bar stock, you're paying for steel you don't use. But Timken® seamless steel tubing comes with *the hole already there.* You pay only for steel you use. On top of this saving, you cut machining costs. By eliminating that unnecessary boring operation, you free part of your screw machines for other jobs—add machining capacity without adding machines.

Our engineers will be glad to recommend the most economical tube size for your hollow parts job. By studying your problem and making recommendations, they'll save you money—and the Timken seamless steel tubing they suggest will be guaranteed to clean up to your finished dimensions.

The piercing process by which Timken seamless steel tubing is made is basically a forging operation. You get *fine forged quality*—a uniform spiral grain flow for greater strength, and a refined grain structure. And through our rigid quality control uniform quality is maintained from tube to tube, heat to heat and order to order.

The Timken Roller Bearing Company, Steel and Tube Division, Canton 6, Ohio. Cable address: "TIMROSCO".

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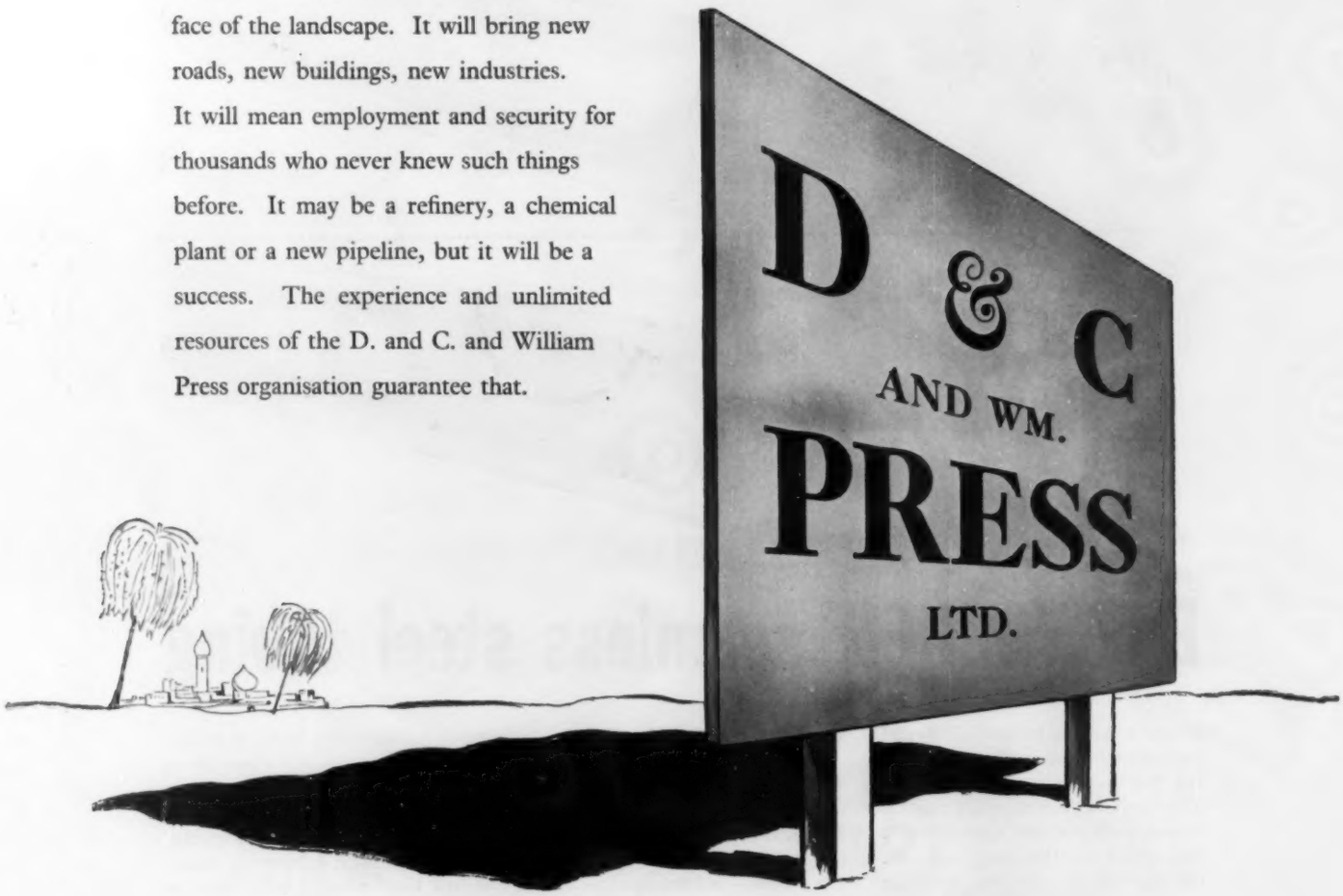
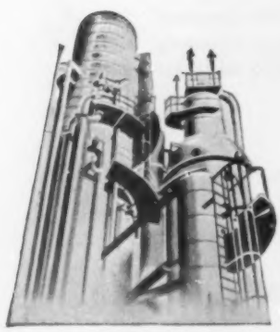
It will be a big project. It will change the face of the landscape. It will bring new roads, new buildings, new industries. It will mean employment and security for thousands who never knew such things before. It may be a refinery, a chemical plant or a new pipeline, but it will be a success. The experience and unlimited resources of the D. and C. and William Press organisation guarantee that.





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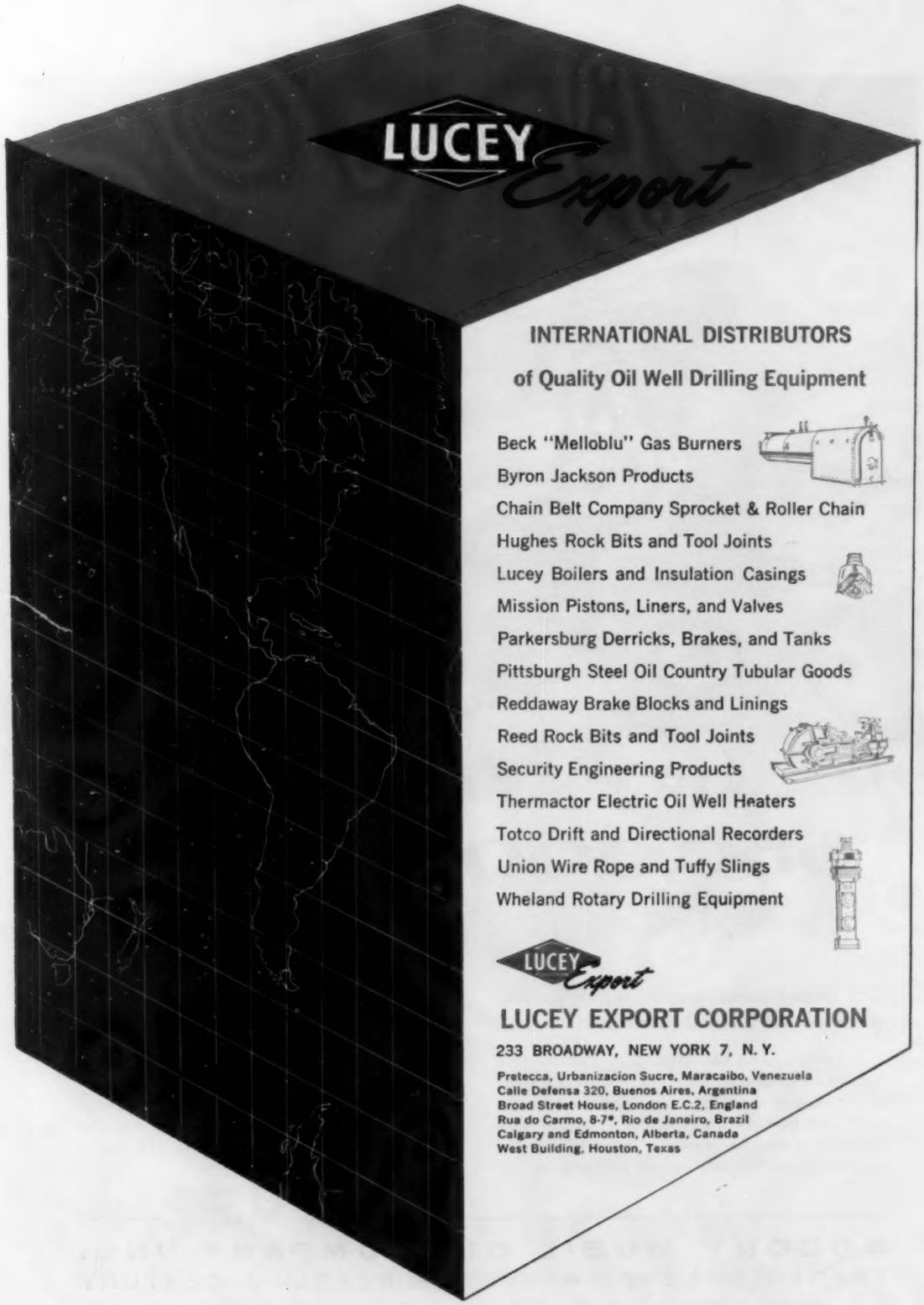

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deliver full measure of honest, rated horsepower!

On this pipe coating equipment, an International Power Unit provides dependable, low-cost power for oil pump, blower heating unit and stirring paddles in mixing pot.

You'll find International engines delivering their full power on jobs everywhere.

They're familiar to irrigation and construction projects. They're seen in oil fields, quarries, mines and lumber camps. And they serve, too, as stand-by electric power in industries and communities.

No matter what the job, International has a wide range of power units with true horsepower ratings to meet your exact needs. Any IH unit you choose has been accurately tested to deliver its full measure of rated power.

All International units are built for heavy-duty industrial use. They feature 4-cycle economy, easy maintenance plus a complete line of accessory equipment for diversified applications.

For complete specifications see your IH Industrial Power dealer—or write for catalog.

INTERNATIONAL DIESEL POWER UNITS

There are six IH diesel units, three 6-cylinder and three 4-cylinder engines from 55 to 200 hp. Money-saving features include:

- All-weather gasoline conversion starting.
- Precision fuel injection system with reserve torque control for extra lugging ability.
- Full-flow oil filtration.
- Unsurpassed fuel filtering system.
- Full-pressure lubrication system with rifle drilled oil passages.
- Heavy-duty power unit components.

Plus many other features that add to low-cost performance.

IH CARBURETED POWER UNITS

Four power-packed 4-cylinder and seven 6-cylinder units are available with hp ratings from 16.5 to 200. Various engines can be equipped to use gasoline, natural gas, kerosene, alcohol, distillate or LPG fuel. IH carbureted units are designed and built to provide maximum power from every drop of fuel.

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Consolidated Safety Relief Valves
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WRITE FOR BULLETIN 56-1

GSI

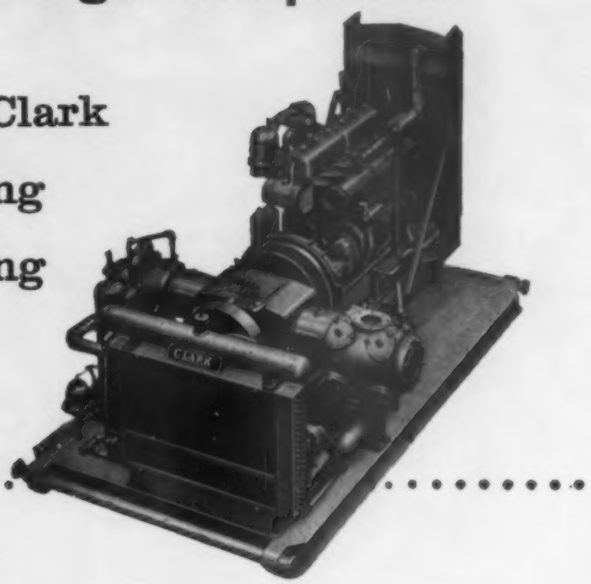
GEOPHYSICAL SERVICE INC.

5900 LEMMON AVENUE • DALLAS 9, TEXAS

A World of Experience in Finding a World of Oil

NOW... a compact 75-200 bhp Packaged Compressor

Designed by Clark for gas lifting or gathering



FEATURES

BALANCED/OPPOSED COMPRESSOR DESIGN
Virtually vibrationless . . . a couple of yards of concrete will level it.

DIRECT CONNECTED
Eliminates belts or gear drives.

ONE PIECE SKID
Only 7′ 3″ x 15′, rigid heavy "I" beam construction.

CONSERVATIVE PISTON SPEED
Lower than on most Clark stationary compressors.

HEAVY DUTY RADIATOR
Straight finned tubes. Easy to inspect or clean, inside or out.

FACTORY ASSEMBLED AND TESTED
No field assembly. Shipped as a complete unit.

STANDARD ENGINE DESIGN
Five makes of proved engine designs available.

APPLICATIONS
Use it for gas lifting, gas gathering, gas boosting, pipeline testing, recycle plant feeders, other field services.

You asked for this field compressor—as rugged, compact and perfectly balanced as the famed "Midget Angle" but of half the horsepower.

Now you have it, in the new Clark Model CFA. Rated at 75-200 bhp , this packaged unit is ideal for gas lifting or gathering.

The CFA uses a new specially designed 5″ stroke Balanced/Opposed compressor directly connected to a standard design gas engine. The compressor and engine, together with radiator, scrubber, etc., are mounted on a rugged steel skid measuring only 7′ 3″ x 15′.

The CFA is virtually vibrationless in operation because of its Balanced/Opposed action. In most cases the small amount of concrete used to level the unit will provide ample support. Direct drive eliminates the need for cumbersome belts and gears.

Easily and speedily transported on an average size truck, this new field compressor can also be operated on truck or floating barge.

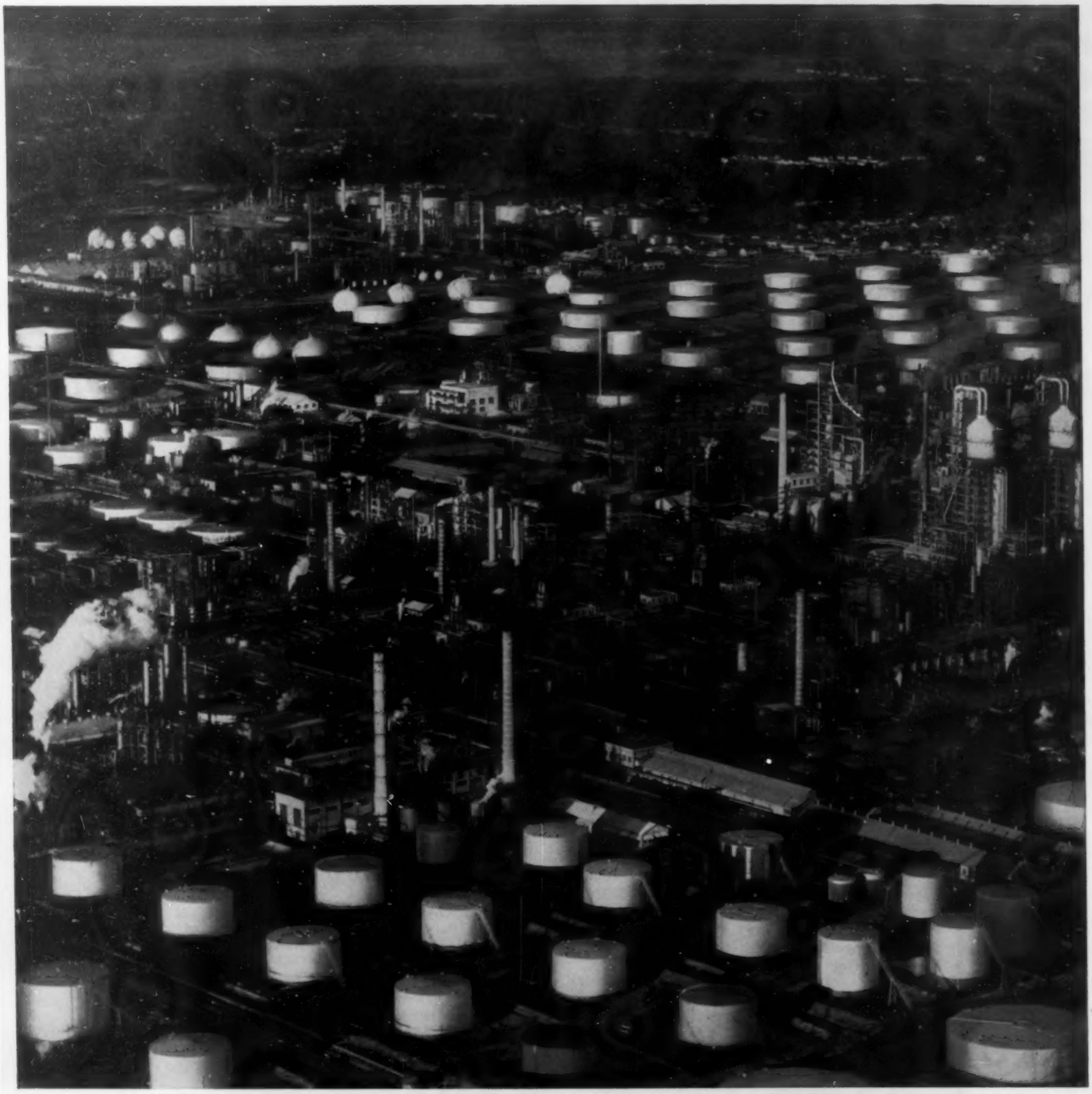
The CFA is factory assembled, tested and shipped as a complete unit. Because of standardization the CFA can be shipped from stock in most instances.

There is a Clark CFA specialist in your area to give you all the facts. If you require greater horsepower, ask him about the Clark HMA and HMAB.

CLARK BROS. CO., OLEAN, N. Y.
ONE OF THE DRESSER INDUSTRIES
Offices in Principal Cities Throughout the World

CLARK®

Packaged Compressors



"Industry must meet the challenge of our expanding economy boldly by investing heavily in plants and equipment, by developing manpower, by devoting more time and money to research, and by improving manufacturing processes. We must also meet this challenge prudently, doing our best to avoid inflationary developments, and to soften the disruptive effects that accompany change. The success of such an effort will give the best proof possible to the world of the soundness of our capitalistic economy, and our concern for the individual, by whom and for whom American industry exists."

— M. J. Rathbone, President, Standard Oil Company (New Jersey)

Esso

STANDARD OIL COMPANY (NEW JERSEY)

AND AFFILIATED COMPANIES

Oil Company Staff Changes

Lloyd W. Elliott

Dyer W. Ramsey

LLOYD W. ELLIOTT has been elected to the executive committee of the Standard Oil Co. (N.J.). Dyer W. Ramsey, Jr., has been appointed coordinator of the company's worldwide marketing activities. Mr. Elliott was president of Standard-Vacuum Oil Co., when he was elected to the Jersey board of directors in 1951.

Mr. Ramsey succeeds William R. Stott who was recently elected a director.

H. W. BROWN has resigned as a director of The Carter Oil Co. to become the representative for Europe and Africa on the New York staff of the coordinator of producing activities, Standard Oil Co. (N.J.). Merrill W. Haas, exploration manager, was elected a member of the Carter Board. He will continue as exploration manager.

ALEXANDER H. CHAPMAN has resigned from the Arabian American Oil Co. to resume his activities as an engineering consultant. Mr. Chapman had been assistant to Aramco's vice president for government relations since 1948. Prior to that he was a partner in the petroleum engineering firm of Hoover, Curtice & Ruby after having served as chief of the foreign production section of the Petroleum Administration for War.

J. C. C. TAYLOR has retired as aviation sales manager of Shell-Mex and B. P. Ltd., London, England. He has been appointed aviation sales consultant to The British Petroleum Co. and is at present on a world tour—which includes the United States and Canada—increasing his knowledge of aviation affairs.

ROBERT G. TRACY has been appointed general manager for all division sales of The Standard Oil Co. (Ohio).

William H. Doyle becomes manager of the Cleveland sales division, replacing Mr. Tracy. Elmer E. Koenig becomes division sales manager in Akron, replacing Mr. Doyle.

G. J. SMITH has been named superintendent of foreign exploration by Stanolind Oil and Gas Co., Tulsa. He has been with Pan-American Production Co. at Houston, which is being consolidated with Stanolind.

Mr. Smith succeeds T. H. Hendricks, who has been appointed consulting geologist for the company after his return to work following a recent illness.

In his new position, Mr. Smith will have charge of Stanolind's exploration programs in Cuba and Jamaica. The company is conducting a multi-million dollar exploration program covering several million acres on the two West Indian islands.

AUGUSTIN PYRE has been named general manager of Gulf Oil Corp.'s New York exploration division. He succeeds Claude Woessner who is retiring after 29 years with Gulf. The exploration division, previously the New York production division, will be responsible for all exploration activities in Caribbean and South American countries except Venezuela.

JOHN C. JACKSON has retired as general attorney for The Texas Co. at Houston. He will be succeeded by Robert J. Derby, who is now assistant general attorney, Houston.

WILLIAM T. PYOTT has been appointed executive vice-president of Pipe Line Technologists, Inc., of Houston, and Don H. Lewis, retired vice-president of Shell Pipe Line Co., elected a director and vice-president. Mr. Pyott has been an officer and director of the Houston engineering firm since 1952, as well as an executive of two pipe line companies operated by the Houston firm under a management contract. Mr. Lewis is well known.

THOMAS J. FREEMAN and James F. Hartnett were recently promoted in the public relations department of the Tide Water Associated Oil Company's eastern division office in New York. Mr. Freeman was named public relations assistant to Jack F. Gow. Mr. Hartnett, editor of Tide Water's dealer publication, was named editor of the employee paper to succeed Mr. Freeman.

GEORGE E. GARLAND has been named manager of the recently established petrochemicals sales division, domestic sales department of The Texas Company. The division will be responsible for market development and sales throughout the country of petrochemical products to be manufactured by Texaco.

W. E. DERMODY, director of advertising for the Gulf Oil Corp., has retired.

A veteran of 22 years of service with the company, Mr. Dermody is widely known in advertising circles as well as throughout the petroleum industry.

L. P. FOOTE, former assistant chief petroleum engineer of The Ohio Oil Co., has been appointed manager of the newly created natural gas division of that company.

C. A. SANDERS has been promoted to director of Credits for Mid-Continent Supply Co. Mr. Sanders, formerly assistant to the treasurer, will continue to be located at the Fort Worth headquarters of the organization.

DR. H. BLOEMGARTEN, a managing director of Koninklijke Nederlandsche Petroleum Maatschappij (Royal Dutch Petroleum Co.) since June 29, 1948, retired June 30, 1956. He has been offered a seat on the board of directors. L. E. J. Brouwer was appointed managing director of Royal Dutch. He was also appointed managing director of the parent operating companies of the Royal Dutch/Shell group.

GUY W. DUREN of Seminole, Texas, superintendent of the Cities Service-operated West Seminole gasoline plant, is being transferred to Bartlesville to serve as senior process engineer in Cities Service Oil Co.'s natural gasoline division. Edgar B. Lord, maintenance superintendent at the West Seminole plant, is being advanced to plant superintendent.

ROBERT P. FERGUSON has been named head of Esso Standard Oil Co.'s expanded economic and marketing research division. The enlarged division will include five sections: merchandising and marketing research; distribution and exploratory research; statistical; economic; and price analysis.

R. J. MAITLAND, who has been general manager of Kern Trinidad Oilfields, Ltd., in Trinidad since 1947, has returned to England to take up an appointment with the Kern group of companies in London. D. G. N. Hannay, assistant general manager in Trinidad, assumed the appointment of general manager.

DR. GEORGE S. BAYS, president, has joined International Petroleum (Colombia) Ltd. as manufacturing manager.

Dr. Bays received M.S. and D.Sc. degrees at Massachusetts Institute of Technology in 1935 and 1936. He later entered the technical service division of the Baytown refinery of the Humble Oil and Refining Co. He held training assignments in the coordination and process departments until he joined International.

Jack G. Hosmer

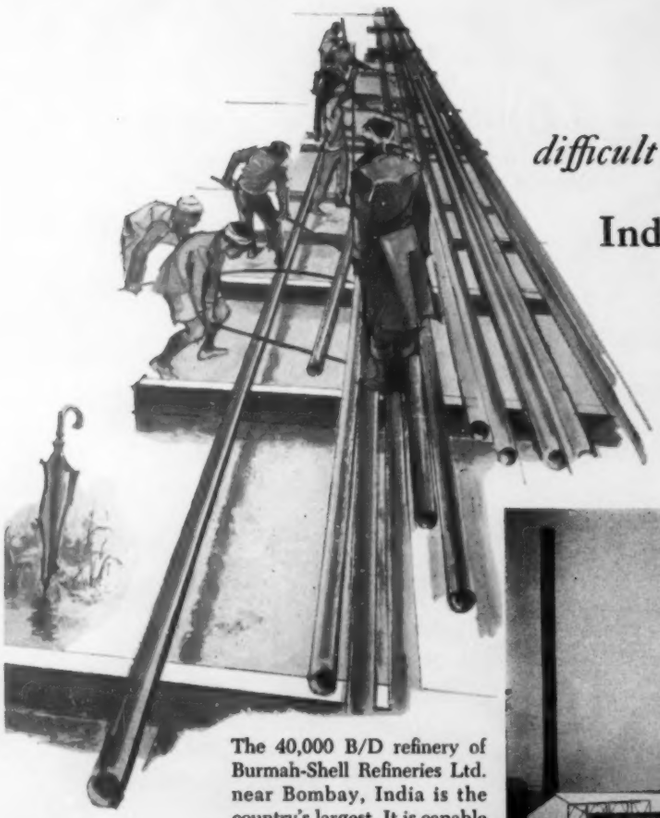
JACK G. HOSMER, former personnel manager of Aramco Overseas Co., has been appointed personnel manager of Arabian American Oil Co. in New York. He replaces George A. Wood who retired on special leave.

George J. Gregor

GEORGE J. GREGOR has been named assistant to Guy L. Tate, director and vice president in charge of marketing for Magnolia Petroleum Co. Magnolia is Socony Mobil's southwest affiliate with headquarters at Dallas, Texas.

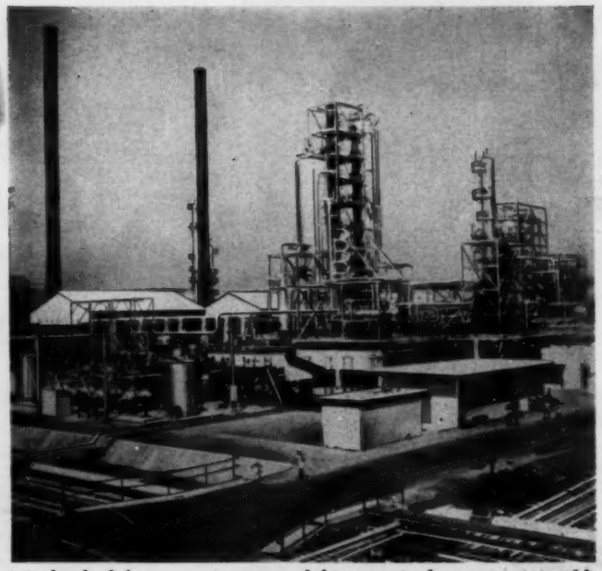
P. H. Hobart

P. H. HOBART, vicepresident of production Gulf Oil Corp. at Tulsa has been transferred to Pittsburgh as vice president, planning and economics. The appointment activates the planning and economics department, a vehicle to obtain information, studies, and recommendations concerning Gulf, the oil industry and business in general.



difficult physical conditions, but...

India's largest refinery was completed a year ahead of schedule



The 40,000 B/D refinery of Burmah-Shell Refineries Ltd. near Bombay, India is the country's largest. It is capable of supplying an estimated half of India's current requirements for finished petroleum. Although built in the face of difficult physical conditions, close cooperation with the owner in planning and engineering, and exceptional coordination of construction allowed Lummus to finish almost a year ahead of the original schedule.

A smoothly running refinery now, consisting primarily of crude distillation, fluid catalytic cracking, gas recovery, treating and blending units, offsite facilities and utilities, at the start it was only 450 acres of incredibly difficult terrain, without roads, railway or harbor.

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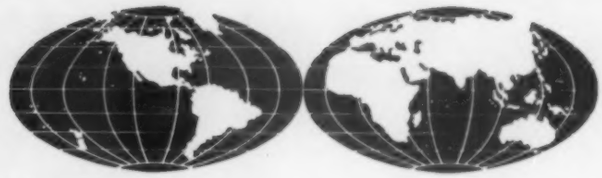

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CONTENTS

4 Washington Pipe Line, *by Joseph B. Huttlinger*

6, 10 International News and Notes

14 Eastern Hemisphere Review

33, 92, 99 Oil Company Staff Changes

37 Editorial—Industry's Growth Raises Problems

38 Slim Hole Techniques Reduce Drilling Costs, *by Philip L. McLaughlin*

42 Abqaiq Pressure Maintenance, *by John M. Wilson*

45 World Crude Output Hits New Peak

46 Progress in Development of Rotary Drilling Bits, *by L. C. Uren*

50 Offshore Workover

52 Electric Drives for Drilling Rigs, *by E. E. Childress*

55 Mobile Drilling Barge Design, *by James W. Calvert*

58 California Tidelands Development, *by L. P. Stockman*

65 Qatar, *by E. Lawson Lomax*

69 Canadian Income Taxes, *by D. A. McGregor*

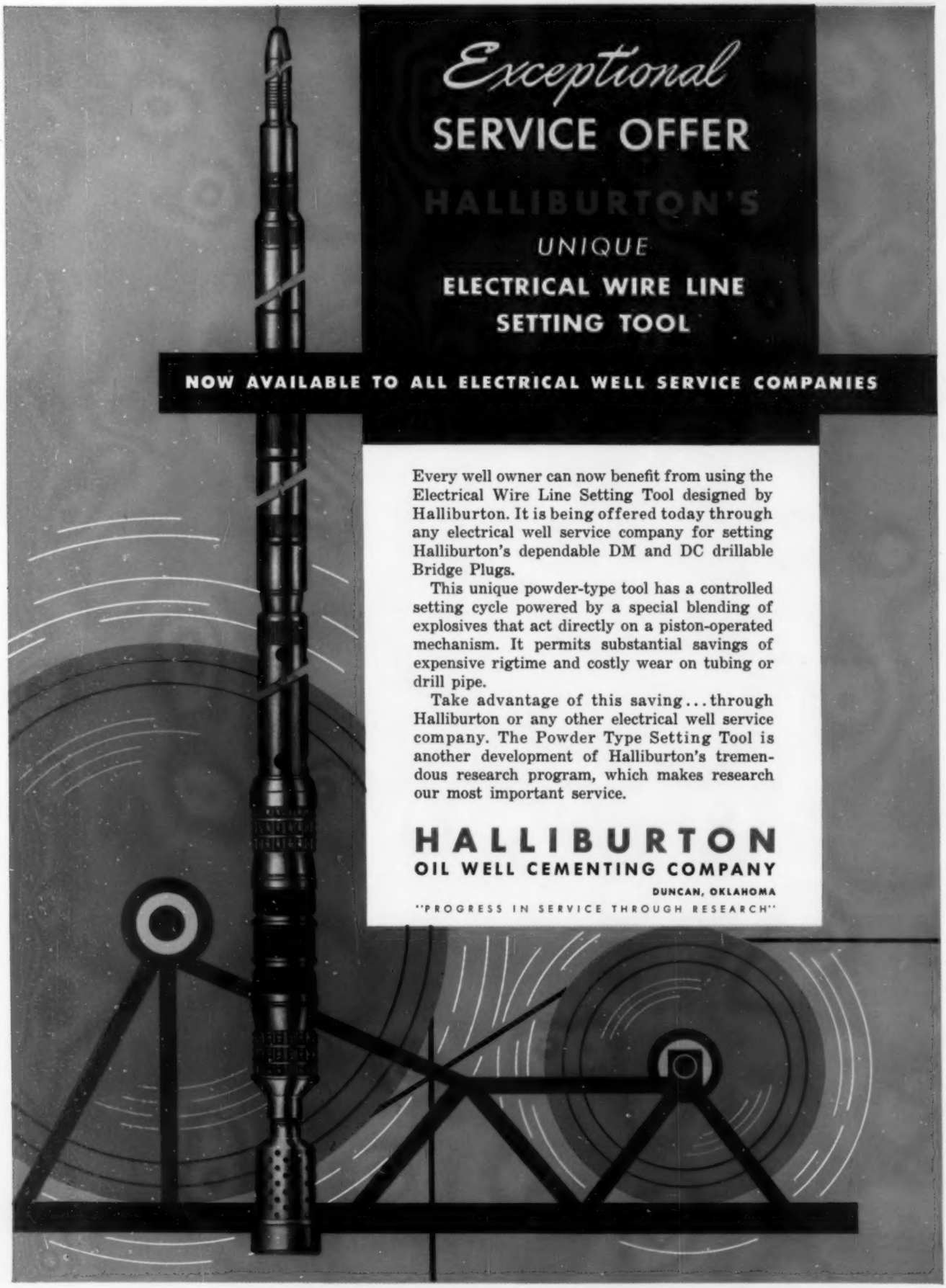
80 Review of U. S. Patents on Petrochemicals, *by Heinz Heinemann and Harold Shalit*

82 London Letter, *by E. Lawson Lomax*

84 Latin American Oil News

86 Canadian Notes

104 Advertisers' Index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Industry's Growth Raises Problems

IN the past decade the statistical picture of the world oil industry has changed significantly and its rapid growth has raised new problems. At the close of World War II, nearly two-thirds of the free world supply of crude was provided by the United States but after ten years positions have been reversed and to meet consumer demand American companies have had to draw on imports to the extent of nearly a million barrels daily. Along with this has gone a doubling or tripling of the cost of finding and producing oil, all of which multiplies the capital investment required to replace withdrawals and add new sources of supply.

Petroleum analysts foresee a continuance of the present trend which by 1965 would double demand from countries now counted in the free world group, raising this supply to nearly 25 million barrels daily, of which a maximum of 10 million may be obtainable from the United States while another 14 or 15 million must be found elsewhere.

The task of adding two million barrels a day to American crude production is a challenging but not impossible one. It faces a declining rate in additions to reserves and particularly in the discovery of fields of profitable size. In an effort to meet the problem before them, American companies have undertaken expenditures of upward of five billion dollars during each of the years directly ahead. In this campaign a primary place is given to more intensive exploration, both in domestic areas and in other countries in which they hold concessions. This will involve more thorough surveys, deeper drilling and the use of improved techniques and equipment, all of which add greatly to the costs of operation.

One direction in which the American industry has committed itself to the outlay of billions in the effort to locate more prolific deposits is the acquisition of leases for exploration and drilling of offshore and Continental Shelf waters. This again is a procedure far more expensive than those conducted from land bases, but hope of success is founded on the operation of productive fields in some offshore areas and from encouraging prospects provided by surveys that have been made, but the gigantic risks involved in a wholesale study of marine areas are such as would deter less optimistic spirits than comprise the oil industry.

A factor that adds tremendously to the investment demands of the modern oil industry is the continual development of new uses and the introduction of processes for the application of greater power or economy to the machines that consume petroleum products. The most active competition within the oil industry in the modern era is that which arises from the frequent introduction of new fuels, additives or mechanical applications, necessitating the installation of new plants that may involve the expenditure of millions or even hundreds of millions. The "octane race" between the builders of automobiles, who year by year are raising the compression rates on their cars, and the refinery engineers, who feel compelled to provide fuels capable of utilizing the fullest engine power that can be developed, is a case in point.

The spirit of progress has been an active force in the oil industry from the beginning of its commercial history. Some of the fundamental improvements in the processing of crude during its earlier years were the outcome of studies and experiments by members of the technical staffs of the refining companies and became important contributors to the company income.

Nowadays "Research" with a capital "R" has become the pole star of the scientists who man the laboratories of the larger oil companies. Their work rooms occupy whole groups of buildings filled with every sort of scientific appliance; their staffs include experts in fields which sometimes relate only indirectly to petroleum and their employees number from a few hundred to a thousand or more. Appropriations for their maintenance run to figures that would have been regarded as fabulous only a few years ago but that have now become major capital investments.

For 1956, one international oil company created something of a stir by making known that it would expend $1.2 billion during the current year, while another announced that it would devote $1.5 billion to the same purpose during the coming five years.

Some time ago, Standard Oil Company (N.J.) published a report covering various details of its research activities. The report makes the statement that in the entire company 1,000 to 1,200 research and development projects may be under way at one time. Viewing research from a purely commercial angle, it discloses that for every dollar the Jersey company has spent in research it has received more than five dollars in direct benefits and adds: "Far greater were returns stemming from widespread acceptance by customers of new and improved products."

Capable of handling well work-over work down to 10,000 feet with a 2⅞-inch tubing or drill pipe, this 128-foot-high rig can be dismantled, moved to a new location and rigged again in 32 hours. (Photo courtesy of Shell Oil Co.)

SLIM HOLE TECHNIQUES

By Philip L. McLaughlin

THE world needs oil to lubricate its industrial axles. Every nation is cognizant of the importance of petroleum reserves. Today, there is strong evidence to suggest that the United States' supremacy as the leader in crude oil production may be lost in the near future.

At present, there is probably enough oil outside of the United States to run the world for some time, however, because of the tremendous importance to the national economies of all nations, we must discover in ever increasing amounts, a continuing supply of oil.

In North America, there is no lack of future supply provided we can maintain the incentive to explore. New ideas and proved techniques for finding and searching for oil must be found. Vast amounts of oil can be made available by developing economic methods of extracting, finding and drilling both new and old reserves.

Drilling costs generally account for 6.9% of the total exploration cost. Wildcatting needs to continue at a high rate in order to maintain reserves at a safe level. High well costs for both wildcats and development wells threaten to choke the economic incentive to drill the needed new wells unless something is done to relieve the situation.

In the United States since late 1952, there has been a considerable revival of interest in small hole or slim hole drilling. Behind this revival, there are some hard economic considerations.

Any of these considerations will bring into sharp focus these existing industry problems:

1. Consumption of oil is likely to double our current peak volumes in the next 20 years. This means the United States will need 14 million b/d in 1975. The oil industry must drill far more wells and vigorously expand its drilling and producing facilities to meet this demand. To elaborate, new uses for oil and gas are being developed daily. World and U. S. population are growing faster than ever before, causing a tremendous growth in U. S. total energy requirements. Atomic power will find industrial acceptance but probably will be used in the electric power generating field first.

2. Investments for new wells have soared out of proportion to the return being realized on these investments. As one illustration, in many areas the average well cost in 1954 was five times greater than in 1936, but the price received for the oil produced was only 2-½ times as much (based on the same daily average rate of production).

3. Another serious problem in the United States is that the developed reserves per well have considerably decreased while the payout periods have increased.

4. The ratio of dry holes to producing wells has increased notably. In the United States, nearly 40% of last year's 55,000 wells were dry.

5. In spite of better geological and geophysical techniques, it is harder than ever to make a really important discovery. Only one well in nine, drilled in search of new oil, ever finds production.

6. One offshore well takes the budget of about 10 or 15 land wells, but the wildcat success ratio is higher offshore. New reserves are costly and important whether on land or under the sea.

7. Drilling personnel are being asked to drill harder formations and deeper holes than were considered economical five years ago at lower drilling prices.

8. Overall costs of producing leases have increased in spite of many recent developments aimed at more efficient, less expensive recovery. A. I. Levorsen recently stated, "only 88 billion barrels of oil, or 32% of the 270 billion barrels discovered in the U. S., is recoverable today." Better and cheaper recovery methods are needed.

9. Allowables are lower today. Produc-

Faced with rising drilling costs, a lower wildcat success ratio and largely unchanged crude markets, producers are turning in greater numbers to slim hole drilling in an effort to reduce the cost of dry holes.

reduce drilling costs

tion in many areas is on the decline. In fact, in Texas 85% of the present wells can be produced efficiently through a 1½-inch tubing, based on present allowables.

10. The industry is plagued with stereotyped lovers of convention who resist changes in accepted exploitation procedures.

Solutions to the above are reflected in the need of drilling economics. Of all of the ways known today to reduce drilling and completion costs, *small hole drilling techniques are the most promising and the least understood.* Coupled with this, we must add air and/or aerated mud drilling, both of which can be used with the slim hole to effect even greater economies in many areas.

Definition of Slim Hole Drilling. From a practical standpoint, slim hole drilling can be defined as the fullest utilization of currently available equipment and drilling practices to reduce drilling and completion costs by reducing equipment and hole sizes. By these standards, the drilling of small holes with full size equipment cannot be considered true slim hole drilling. There must be a good balance between drilling equipment size, drilling techniques, and hole size before it can be considered good economic practice.

As proven by past performance, today's slim hole may be tomorrow's regular hole. Practical slim hole then is an evolutionary —rather than a revolutionary—development.

Slim hole sizes for this discussion shall be confined to 6¾-inch maximum and 4¾ inches minimum.

Objective of the Slim Hole. The chief objective of the small hole is to provide a bore hole to a given depth at a lower total cost than possible with a conventional hole. The hole must be economical and of adequate size to furnish geologic and reservoir engineering information.

Once production is established and the producing requirements are set forth, then it would follow that the second objective would require that the hole be suitable for installing a conduit of small diameter casing or tubing for bringing subsurface fluids to the surface.

At this point, it should be pointed out that until recent equipment developments, a divergence of opinions existed. Exploration people believed slim holes to be exclusively an exploratory tool to test certain objective sands. They successfully drilled several exploratory slim holes for the price paid for one big hole.

Today, many drilling and producing people believe recent technical well services and equipment developments are available, to case the smaller hole with casing sizes down to 2⅞ or 3½ inches OD, provided consideration be given to reservoir fluids, reservoir drive mechanisms, and provided that the small hole is satisfactory for producing a good percentage of reservoirs currently developed without excessive workover problems.

Present Status of Slim Hole. In soft rock country, there is a mass of evidence to indicate that slim hole drilling techniques can reduce drilling costs from 10 to 50% when appropriate rigs are used. Drilling time recently has been comparable with conventional sized holes, because of improved bit designs in the smaller sizes.

In hard rock country, the picture is not nearly so clear. Here, moving costs are not such a high percentage of over-all well costs, and bit life is much more important.

Air drilling also appears to offer considerable promise in conjunction with slim holes in hard rock areas. The general effect of air drilling is to improve bit footage and penetration rates and to reduce the percentage penalties of the small bit sizes. Normally, half the drilling mud weight on the bit is necessary as used by conventional rigs. The balance swings heavily in favor of diamond bits for slim holes in hard formations.

Pattern in pipe stacked ready for use at the Shell Oil Company's Good Hope field at Norco, Louisiana. (Photo courtesy of Shell Oil Co.)

Another tool that promises to alter the slim hole picture in hard rock areas is the percussion bit.

From the above facts, we can safely conclude that while slim hole drilling has not yet been proved in most hard rock areas, it is definitely not a dead issue.

Slim Hole Completion. Slim hole completions (using 2⅞-inch tubing as casing, 4-inch tubing, 4½-inch casing or 4-inch line pipe) have been used with success in several areas.

It is too early to tell exactly how long this equipment will last as compared to larger equipment in regular sized holes.

Huber, Faulk, and McLaughlin, at the 1955 Fall Meeting of the AIME in New Orleans, presented evidence that slim hole drilling and slim hole completions are definitely practical. Slim hole completions may have some disadvantages as compared to regular completions, but they also have many advantages. "Today, essential testing can be performed in a 3¾-inch hole and primary logging information may be obtained in 2-inch holes. These holes can be produced satisfactorily since artificial lift and workover equipment is available for wells equipped with 4-inch casing and 1½-inch tubing. All permanent will completion tools and techniques are developed for 1½-inch completions." Because of these relatively new developments, many leading producers are looking to slim holes for field development, as well as for exploration.

Producing requirements of a large percentage of wells can be handled by 1½-inch tubing today as evidenced by the fact that about 85% of the wells in Texas fit this category, based on present allowables.

The lessened need for conventional artificial lift resulting from increasingly popular fluid injection programs will emphasize the adequacy of small holes for a wide range of conditions.

It is anticipated that the following developments may come about in small holes:

(a) The 4-inch casing—1½-inch tubing setting will probably be the most acceptable program for the near future.

(b) For some reservoirs, 2⅞-inch OD casing settings, with or without tubing may be desirable. Marginal reservoirs have to be economically exploited.

(c) Parallel strings of tubing may be cemented instead of casing.

(d) Successful small holes, possibly in the 3-inch or smaller sizes, may make it possible to completely change the system of sinking a well, since much less material is excavated.

(e) It appears that drilling hydraulic systems may be greatly simplified if small-hole bits are developed which, instead of chipping, successfully pulverize all types of formation.

From the above facts, we may conclude that slim hole completions are definitely practical. They may have some disadvantages as compared with regular completions but they also have many advantages.

From this record, it is not possible to justify a "blanket conclusion" that slim hole completions are not practical. It is necessary to conclude that they are practical for many applications.

Industry Acceptance. The facts of record indicate that slim hole drilling and completion techniques should be receiving wider acceptance. Since technical considerations fail to explain the lack of acceptance, it is necessary to examine the attitudes of producers and drilling contractors to see if an explanation can be found.

The problem boils down to this—"How can operators and contractors establish a 'climate' so that contractors can reap enough added profits to make slim hole drilling attractive without assuming too much of the added risk?"

Producers who have used slim hole drilling have been generally pleased with results even though they have not used slim hole completion techniques!

Drilling contractors, on the other hand, who have not had a real market, until just recently, have been generally displeased with their slim hole experiences previously. While low profits, unsatisfactory bit performance and unfavorable contract situations were the most frequent reasons given, unsuitable rigs seem to be a contributing factor in many cases. Proper balance between equipment and hole size was forgotten in most cases.

The main obstacles to slim hole drilling at the present time are:

1. Lack of acceptance of slim hole completions.
2. Poor contract situation. Risk-profit relationship has not been fully examined.
3. The greatest profit or savings favor the operator, not the contractor. (However, slim hole contractors are making better percent profit than many big rig contractors.)
4. Lack of information on the part of contractors.
5. Inadequate drilling equipment.
6. Poor comparative bit performance in the past.
7. The need for different drilling techniques on the part of the contractor.
8. The psychological reluctance on the part of the contractor to "downgrade" himself.
9. The psychological resistance by both contractors and operators to change.

Industry Changes That Might Improve Slim Hole Picture. The following steps, if taken by the drilling and producing industry, could accelerate the widespread use of slim hole techniques. If this is done, substantial cost reductions will result.

An intensive program of education is indicated to make producers (particularly independent operators) aware of the benefits to be realized from slim hole completions of field development wells. This is a big job and it might be undertaken jointly by equipment manufacturers, major oil companies, technical societies and producer groups.

Standard contract provisions for both "day rate" and footage contracts should be reviewed in the light of the special requirements of slim hole drilling. Equipment depreciation rates should be reconsidered in terms of actual service records of small rigs. Such questions as obsolescence may well be considered.

It can be expected that the different size and nature of slim hole rigs will result in a different tax and insurance picture. Suitable experts should be consulted in an effort to establish equitable practices in all phases of the depreciation picture.

Contractors and producers should carefully study the entire risk profit relationship and should arrive at a mutually suitable division of risks and profit opportunities.

While it is true that each individual contract is a separate problem, industry-wide discussions would prevent many inequities that might otherwise occur.

With slim hole drilling being conducted on an ever-expanding scale, leading rig manufacturers are developing equipment that will make slim hole drilling more economical than ever before.

Continued improvement in bit performance is essential, since it influences so many factors in over-all drilling costs.

Roller bit performance in the slim hole sizes has been substantially improved in

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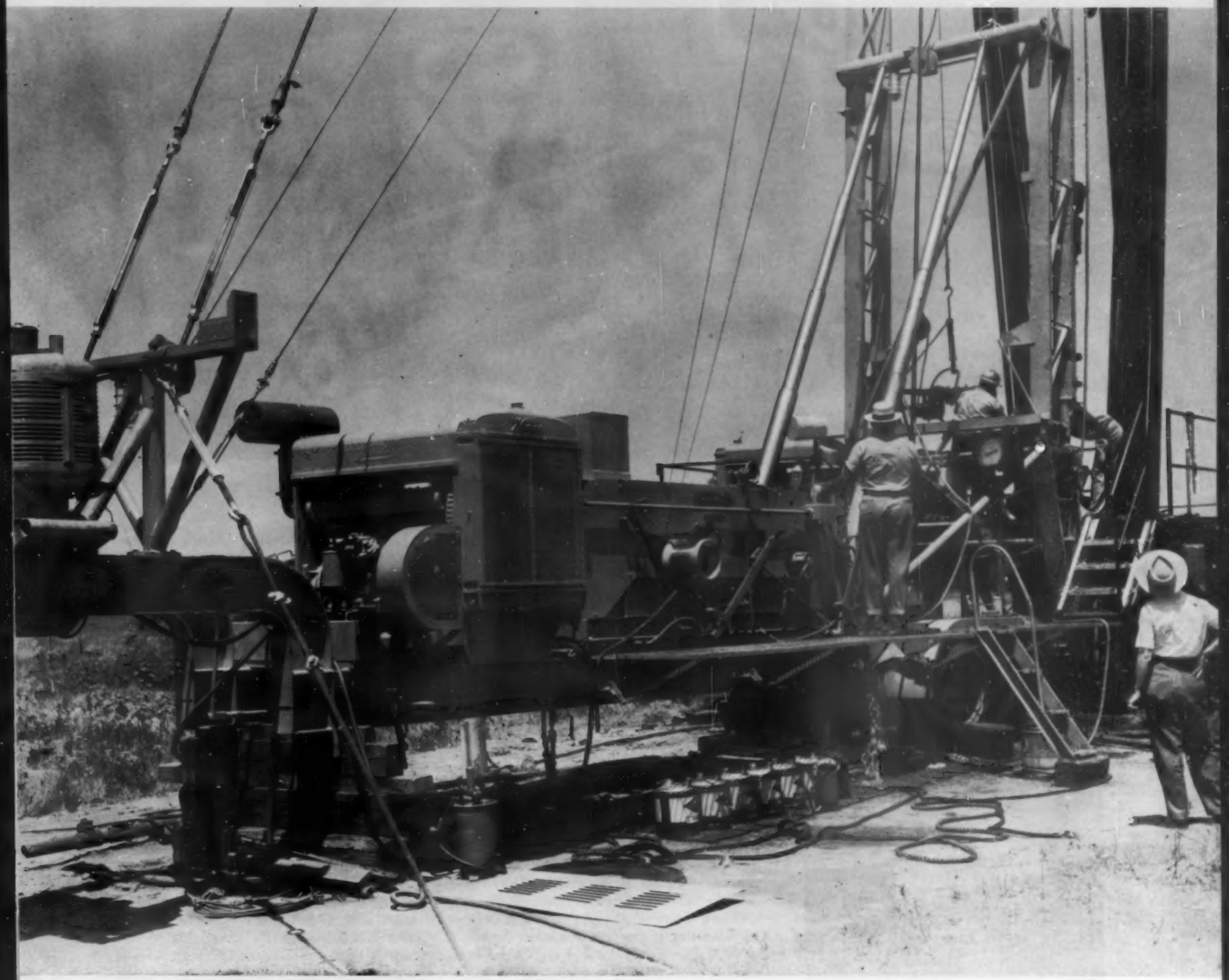
Philip L. McLaughlin is manager of the new product and drilling research department of Cardwell Manufacturing Co., Wichita, Kan. He was drilling editor for World Oil *prior to joining Cardwell as advertising manager in 1952.*

Following his graduation as a petroleum engineer from the University of Texas, Mr. McLaughlin was with Ohio Oil Co. in West Texas and in district offices at Houston.

Mr. McLaughlin has been active in professional societies and is currently co-chairman with William Clift of Humble Oil and Refining Co. of the Southwestern District API study committee on surface mud systems. He is active on various committees of the American Association of Oilwell Drilling Contractors, the API and the American Institute of Mining and Metallurgical Engineers. Much of his work is in connection with techniques of drilling with air and the use of smaller diameter well bores.



In order for slim hole economies to be evident, proper balance must be maintained between hole size and drilling equipment for any given depth. Note that this small equipment is performing a job formerly done by a rig costing twice as much. (Photo courtesy of Cardwell Manufacturing Co.)

recent months. The fact remains, however, that the big bits are still giving better results. There seems to be basic reasons "why" big bits will continue to out-perform small sizes.

Fast drilling is not essential with slim hole rigs if low drilling costs are to be achieved, that is, within limits. In some cases, a small rig could take 23 days while a big rig required only 10 days—but the drilling costs were equal.

Deviation limits should be reviewed. It is obvious that deviation limits are going to have to be relaxed if satisfactory penetraton rates are to be maintained.

While "3-degree" contracts have been the industry standard for many years, progressive elements of the drilling industry are investigating higher maximum deviation limits provided that the rate of deviation change is not greater than three degrees for any given hundred feet.

There is every reason to expect that with this broad acceptance of the small diameter hole as a means to complete economically more wells for the same amount of money, the substantial drilling efficiency is possible. If the big hole does not provide the optimum answer, then perhaps slim hole techniques hold the only alternate based on our present concept of drilling equipment.

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Arabian American Oil Company is employing both gas and water injection techniques simultaneously to maintain optimum reservoir conditions in the famous Abqaiq field.

ABQAIQ PRESSURE MAINTENANCE

By John M. Wilson

John M. Wilson is assistant to the vice president, technical and supply services, of the Arabian American Oil Company. Born in Louisville, Kentucky, he spent three years in the Army Combat Engineers and served in the European Theater of Operations during World War II. He graduated from Massachusetts Institute of Technology in 1948 with two Bachelor of Science degrees, in Chemical Engineering and in Business Administration. Subsequently, Mr. Wilson was employed by Nickel Cadmium Battery Corp. and by Lederle Laboratories. Since coming to Aramco in 1952 he has been engaged in long-range studies of pipe lines, pump stations and stabilizing plants.

THE Arabian American Oil Company stands in a favorable position compared with most oil producers in the United States and with many throughout the world. In the oil reservoirs in Saudi Arabia, where Aramco operates, the high porosity of the producing formations enables the natural energy of solution gas combined with water influx to provide naturally flowing wells of great productivity. Also, Aramco is the sole operator in its concession area, and can plan production rates and surface facilities for maximum economy and minimum waste. As a result, a minimum number of wells are drilled on a wide pattern of spacing. Aramco has not had the problem faced by early producers in the United States, who could lease only a fraction of any pool, and who had to drill offsets to prevent drainage of the property and thus to make sure the owners got their share.

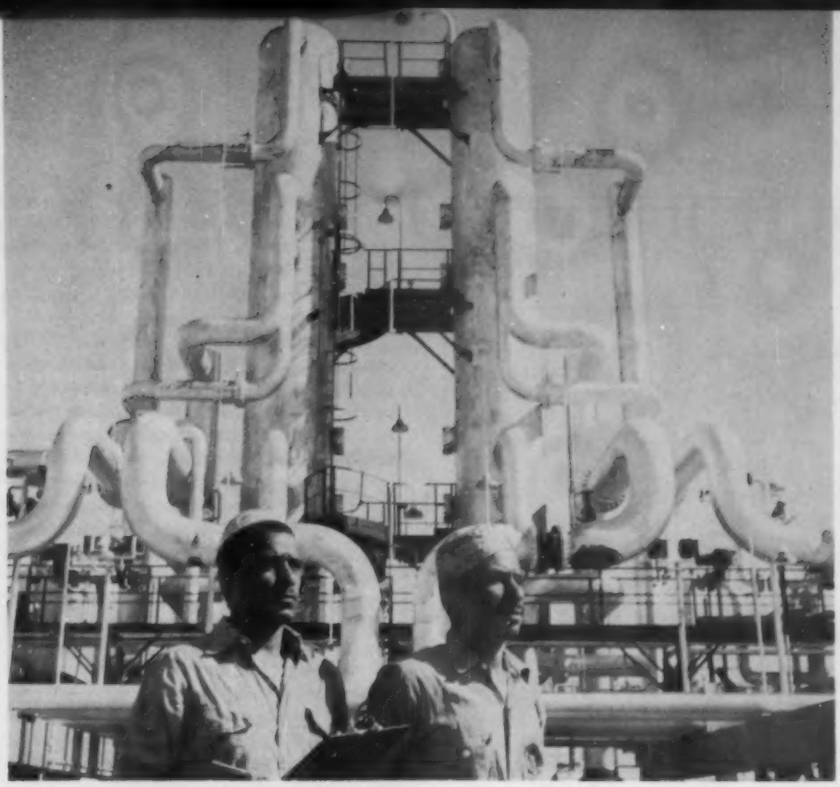
It is the company's obligation and desire to make use of the best available methods of production. This means: (1) it follows careful production practices; (2) it conserves the gas produced with the oil wherever possible. These two considerations are closely bound together, and the conservation of solution gas has materially increased oil production. Aramco's management has always looked upon conservation as a particularly important part of its obligation. It feels that only in this way can the greatest long-range benefits to everyone be achieved. This is also a matter of considerable importance to the Saudi Arab. The Saudi is proud of his nation's resources and will not sanction wasteful procedures for the sake of immediate, shortsighted increases in monetary returns.

The amounts of gas available in Saudi Arabia have been subject to much controversy and misinterpretation. Contrary to popular opinion, the amount of gas flared is not large. No "free" or nonassociated gas is produced, and only that gas produced with the oil is available. The energy of the high pressure gases is utilized by expansion turbines which drive oil shipping pumps on the pipeline system. Much other gas is drawn off for use as an industrial fuel and in gas appliances in employees' homes. The older fields in Saudi Arabia, such as Dammam and Qatif, have declined to a point where the gas produced is almost insufficient to meet local needs for fuel. The practice of using gas expansion turbines in these areas has already ceased.

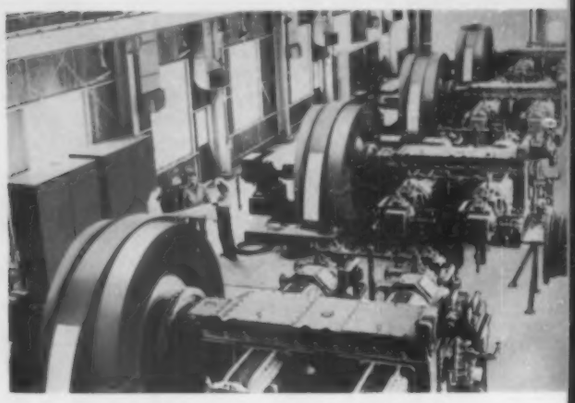
At Abqaiq, one of the major oil fields of the world, the bulk of the gas produced is now used to maintain the pressure of this reservoir. This field is situated in the eastern portion of Saudi Arabia within 50 miles of the Persian Gulf (see map). The reservoir is an anticlinal structure about 25 miles long and 6 miles wide, and covers nearly 90,000 acres. The producing formation is predominantly oölitic with a total thickness averaging 200 feet. Water influx occurs at the edges only, and its effectiveness in backing up the solution gas drive is somewhat limited. At its peak, Abqaiq produced nearly 600,000 barrels daily from a total of 66 wells, some of which were used for observation only. Today its production is more nearly half of that because of pressure decline.

When production at Abqaiq commenced in 1946, the reservoir pressure was on the order of 3400 psig. By mid-1949, the pressure had declined to about 2950 psig, and a gas cap had begun to form at the crest of the structure where the pressures were somewhat less. As a result, two adverse factors developed:

1—The lower reservoir pressure reduced the flow potential for each well. This reduction was serious because in Saudi



The twin dehydration columns at the Abqaiq gas-injection plant. Here the gas is dried before it is compressed and reinjected into the producing formation.



The four reciprocating compressors in the Abqaiq compressor house. These four, together with four centrifugal compressors, are the principal components of the compressor house.

Arabia only those wells are drilled which are indicated by studies to give maximum benefits. The loss in potential was about 1,000 b/d for each 100 psi drop in reservoir pressure. By mid-1949, there had been a loss of almost 4,500 b/d per well as compared to the flow theoretically obtainable at the original pressure. If the pressure decline were not arrested, production could only be maintained by drilling more wells. Worse yet, some day the wells would cease flowing naturally. Then Aramco would be faced with the necessity for expensive pumping or gaslift installations spread out over the whole field.

2—If other than solution gas were produced from the gas cap, there would be a corresponding removal of reservoir material without useful production. For this reason, a large number of wells on the crest of the field which showed relatively high gas-oil ratios were shut in. However, some have been put back in production at reduced rates. At present, nine wells are shut in because of high gas-oil ratios. Two of these have been put back to use as gas-injection wells.

The only reasonable course of action open to Aramco's management if production rates were to be maintained was to stop the decline in reservoir pressure. As reservoir fluid is removed, there is a natural water influx which, however, is sufficient to support only a fairly low rate of withdrawal. The difference between the production caused by water drive and that deemed by Aramco to be the optimum could be obtained in two ways: (1) by replacing with reinjected gas the extra reservoir fluid; (2) by injecting water to increase the influx rate.

Of these two possibilities, gas injection appeared to be much more desirable as a first step, because it enabled Aramco to effect an important conservation measure. Two advantages were gained by this step: (1) the gas would be conserved; (2) higher well potentials would be sustained. It was also possible that gas injection might increase the ultimate recovery of oil because it assists gravity drainage by driving the oil downhill from the crest of the field. In addition, the increment of oil production to be made available by the gas-injection project was considered by Aramco's management to be worth the cost.

Therefore, the Company decided to build a gas-injection plant in the Abqaiq area. Construction was started in 1951 and completed in 1954. The plant went into operation on March 25, 1954, and represents an investment of approximately $20 million. Today it is returning the available gas to the producing formation at the rate of 160 million cubic feet per day.

However, the lower production rates now effective at Abqaiq limit the supply of gas for injection, and gas injection alone does not produce enough benefits to take full advantage of existing surface facilities. For these reasons, the Company plans to put into operation in 1956 in the Abqaiq area a pilot plant to explore the problems of water injection. This project will draw water from three specially drilled wells and inject it into the reservoir through three other wells. This may be an important step, because most oil fields in Saudi Arabia lie in the same structural horizon and are thus influenced by the same widespead aquifer. Already, declines in reservoir pressure have resulted in conditions of pressure interference between fields. This behavior will become more pronounced in future years, and water injection may be one means of offsetting it.

The gas-injection system itself is relatively simple. Gas produced with the oil from the Abqaiq reservoir is removed in separator vessels at three collecting stations, called gas-oil separator plants (abbreviated GOSP). These GOSPs are spread out along the axis of the field (see map). The gas is collected by means of a thin-wall, fully restrained pipeline of 20-inch diameter and brought to the gas-injection plant, which is located near the field's crest. The gas flows through this system under its own pressure, and no compressors are used to boost the flow. The gas leaves the separators at 500 psig and arrives at the injection plant at about 430 psig, where it is compressed to 3000 psig for injection. The gas from all GOSPs is brought down to the southern part of the reservoir for injection to keep down the cost of injection lines and to make the best use of the structural characteristics of the reservoir.

Tests made at the GOSPs showed that the high pressure gas is sometimes fully saturated with water. At the wellhead, the gas is quite warm, and as it is brought through the long collecting system, it cools down considerably and some condensation of hydrocarbons and of water results. As yet, corrosion problems have not been severe in spite of the presence of hydrogen sulfide (H_2S), probably because no oxygen can enter the system. At the gas-injection plant, the condensate is removed by means of a scrubber. Because the compression of the water-saturated gas followed by intercooling would cause further moisture condensation, the gas is dried out before compression begins. Two dehydrating columns are used. One of them is "on stream" at any given time, while the other is regenerated with hot gas. A portion of the total gas stream is dehydrated more or less completely and then recombined with remainder to give the required reduction in dew point. The drying agent used in an alumina

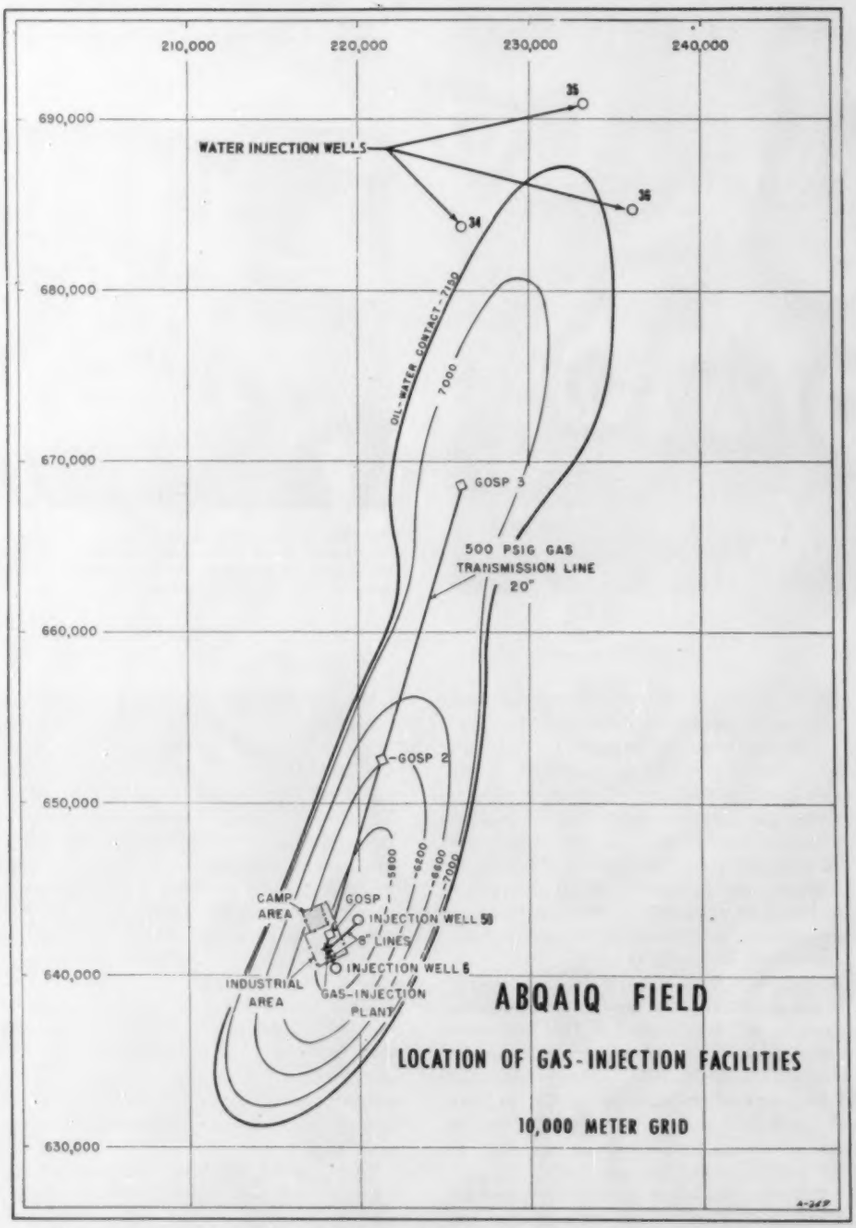


Diagram of the Abqaiq field, showing the location of the gas-injection plant and other facilities.

An exterior view of the compressor house, the heart of the gas-injection plant. Here the gas is compressed from about 430 to about 3,000 psig for injection.

desiccant suspended in three separate layers inside each column. The gas next is passed through a filtering system to keep desiccant particles out of the rest of the plant. Then it goes to the intake of the first-stage compressors.

A major criterion in the design of the compressors, in accordance with Aramco policy, was that no untried equipment be used; any equipment that fails in Saudi Arabia is a long way from home, and as a result such failure can be very expensive. A sufficient record of experience was available for centrifugal compressors operating up to about 1000-1100 psig. This equipment was chosen for the first two compression stages. For the high pressure stage, however, reciprocating equipment was chosen.

The first stage of compression consists of two Clark centrifugal compressors operated in parallel, each having a Westinghouse steam-turbine driver. The gas is compressed from about 430 psig to about 750 psig, and is discharged into an air-cooled, finned tube exchanger for interstage cooling. From there it goes to a scrubber which removes liquid hydrocarbons to protect the second-stage compressors. There is about a 25-psig drop between the compressor stages.

The second stage of compression is similar to the first, and raises the pressure from about 725 psig to about 1085 psig. The gas is then cooled and scrubbed in equipment similar to that used following the first stage.

The third stage consists of four Clark reciprocating compressors arranged in parallel with synchronous electric-motor drivers. The gas is compressed to an outlet pressure of about 3000 psig for injection. The gas goes directly from the discharge of these compressors through two 8-inch injection lines to wells AW-50 and AW-6. These lines have walls three quarters of an inch thick.

The gas-injection plant compresses only the gas from the 500-pound separators. There are other, lower stages of separation which on the aggregate produce about half as much gas. These low pressure gases are used for fuel at the Abqaiq industrial area. When the field was first developed, the oil was shipped via pipeline using expansion turbines as pumpdrivers. These turbines expanded the 500-pound gases down to low pressure for the energy source. The plans for injection had to include the replacement of these turbines by electric motors or steam turbines and the construction of power plants to furnish the electricity required. In the industrial area, steam turbines were selected instead of motors so that additional low pressure process steam would be available at the stabilizer plant, where poisonous hydrogen sulfide is distilled out of the crude to make it safe for shipping and storage.

Today the initial problems of operation have been overcome, and the plant is returning about 160 million cubic feet per day to the reservoir. In this way, it is possible to sustain high rates of production without loss of reservoir pressure, and to defer the significant amount of investment which otherwise would have been necessary to expand other producing areas. END

World Crude Output Hits New Peak

WORLD production of crude reached a new peak of nearly 16,784,300 b/d during the second quarter of 1956, an increase of 9.2% above the average for 1955. some second quarter figures are estimates.

Second quarter world output rose about 2.3% over the first quarter in 1956, due mainly to increases in the Middle East. In this prolific part of the world output averaged 3,850,500 b/d, up 12% over first quarter levels. Outstanding increases were shown by Kuwait and Iran. Israel produced about 300 b/d during the quarter, as the newest arrival to the ranks of Middle Eastern oil producers.

Other major countries of the Eastern Hemisphere showed little change. Europe and North African production stayed about the same, although France continued to increase and contributed the largest increase in the area as Parentis and Mothes discoveries were steadily drilled up. Asia and Australasian levels did not change much.

Decreases in production occurred during the second quarter in the Wester Hemisphere, primarily due to decreases in Venezuela, and Canada with the coming of warmer weather. Venezuela dropped about 1.7% to 2,672,300 b/d as demand for light fuel oil, especially in heating, declined. Canadian production dropped with the coming of warmer weather by about 7.5%, down to 408,000 b/d during the second quarter.

United States production increased slightly during the second quarter, although the United States' share of world production continued to decline. Second quarter levels were only 42.6% of world production, compared with 44.7% in 1955. North America's share of world production declined from 48.6% during 1955 to 46.6% in the second quarter.

South America's share of world production declined slightly during the second quarter, due principally to the decreases in Venezuela. The total South American share went from 16.4% in 1955 to 15.9% in the second quarter of 1956.

The Eastern Hemisphere continued its rise in proportionate output, rising from 34.9% in 1955 to 37.5% in the second quarter of 1956. This rise is primarily due to the increases in the Middle East, where Iran rose from 2.1% of world production in 1955 to 3.4% in the second quarter of 1956. Kuwait also increased its share slightly, from 7.2% in 1955 to 7.4% in the second quarter.

The share of the Middle East increase from 21.6% in 1955 to 22.9% in the second quarter, reflecting the rising importance of this area which has the majority of world reserves.

In Europe and Africa the proportionate share fell slightly from 11.4% in 1955 to 11.1% in the second quarter of 1956. This is not due to an absolute decrease, of course. The Parentis field increased its output somewhat during the year but the area as a whole fell behind.

In Asia and Australasia the producing fields are generally old and producing rates are stable or declining. The only promising discovery in British Borneo since the end of World War II, the Jerudong well, has proved less encouraging than originally hoped when the third, fourth, and fifth wells were dry. A new concession granted to the Dutch New Guinea Petroleum Co., owned by Standard Vacuum, Shell, Standard of California and the Texas Company may indicate an increase in exploration in this important and crude-deficient general area.

PERCENTAGE DISTRIBUTION OF WORLD CRUDE PRODUCTION

Principal Countries	Second Quarter 1956	1955	1954
USA	42.6	44.7	46.4
Venezuela	15.9	14.2	13.8
USSR	9.3	9.3	8.4
Kuwait	7.4	7.2	7.0
Saudi Arabia	6.3	6.4	6.9
Iraq	4.5	4.6	4.6
Iran	3.4	2.1	0.4
Canada	2.4	2.3	1.9
Mexico	1.6	1.6	1.7
Indonesia	1.5	1.5	1.6
Principal Areas			
North America	46.6	48.6	50.0
Middle East	22.92	21.6	20.4
South America	15.9	16.4	16.3
Europe & Africa	11.1	11.4	11.1
Asia & Australasia	2.4	2.5	2.5
Eastern Hemis.	37.5	34.9	33.7
Western Hemis.	62.5	65.1	66.2

WORLD CRUDE OIL PRODUCTION
(Thousands of Barrels Daily)

	1956 Second Quarter	1956 First Quarter	1955 (Year)	1954 (Year)
United States	7,140.5	7,106.1	6,775.6	6,346.0
Canada	408.7	441.2	354.6	262.7
Mexico	263.0	252.6	244.7	226.8
Total N. America	7,812.2	7,799.9	7,374.9	6,835.5
Argentina	81.7	84.4	83.7	81.3
Bolivia	8.2	8.5	7.4	4.5
Brazil	7.1	6.9	5.5	2.6
Chile	9.2	8.4	7.1	4.8
Colombia	118.0	115.3	108.8	109.5
Cuba	1.6	1.5	1.0	0.2
Ecuador	9.8	9.9	9.7	8.4
Peru	48.0	48.0	47.2	46.7
Trinidad	75.0	74.6	68.2	65.0
Venezuela	2,313.7	2,353.7	2,157.2	1,897.2
Total S. America & Caribbean	2,672.3	2,711.2	2,495.8	2,220.2
TOTAL W. HEMISPHERE	10,484.5	10,511.1	9,870.7	9,055.7
Algeria	.8	1.0	1.3	1.6
Austria	64.6	65.4	68.2	62.0
France	23.3	21.6	17.0	9.8
French Morocco	2.2	2.2	2.1	2.4
Germany (West)	65.0	63.8	60.3	51.8
Italy	8.5	8.1	3.5	1.5
Netherlands	20.0	18.5	19.6	17.6
United Kingdom	1.4	1.3	1.2	1.2
Total W. Europe & N. Africa (Excl. USSR)	185.8	181.9	169.8	152.3
Albania	6.0	6.0	6.0	3.0
Czechoslovakia	3.0	3.0	4.0	2.5
Hungary	35.0	35.0	24.0	14.0
Poland	7.0	7.0	6.0	4.0
Romania	223.0	223.0	200.0	150.0
Yugoslavia	3.0	3.0	3.0	
USSR	1,568.0	1,568.0	1,412.0	1,145.0
Total USSR & Sat.	1,845.0	1,845.0	1,655.0	1,318.5
Bahrain	30.0	30.0	30.2	30.1
Egypt	36.0	36.0	34.9	37.7
Iran	564.4	439.1	326.0	56.0
Iraq	760.0	631.4	691.9	628.7
Israel	.3	.3		
Kuwait	1,242.2	1,141.6	1,092.6	955.8
Neutral Zone	30.0	30.0	24.2	16.5
Qatar	127.5	126.1	114.5	104.9
Saudi Arabia	1,054.1	1,007.7	965.0	952.6
Turkey	6.0	6.0	3.5	1.1
Total Middle East	3,850.5	3,438.2	3,282.8	2,783.4
British Borneo	116.6	114.8	107.0	96.8
Burma	5.0	5.2	4.4	3.4
China	13.4	13.4	13.4	2.0
India	7.5	7.5	7.1	6.8
Indonesia	257.0	255.0	234.0	218.1
Japan	5.9	5.9	6.1	5.9
New Guinea	8.0	7.5	9.4	10.8
Pakistan	5.1	5.1	5.7	5.0
Total Asia & Australasia	408.5	414.4	387.1	350.8
TOTAL E. HEMISPHERE	6,299.6	5,879.5	5,494.7	4,605.0
WORLD TOTAL	16,784.3	16,390.6	15,365.4	13,660.7

Running pipe in Hackett No. 1, a Cities Service test near Stettler, Alberta. (Photo by Anthony Linck for Cities Service Co.)

PROGRESS IN DEVELOPMENT OF ROTARY DRILLING BITS

By L. C. Uren
Emeritus Professor of Petroleum Engineering,
University of California.

The accompanying article by Prof. Uren is the first of a series which will appear in WORLD PETROLEUM. *The next three months will be devoted to a study of Progress in Reservoir Technology.*

Prof. Uren is author of the Oil Producer's Library, *consisting of three volumes. His volume on Petroleum Producing Engineering—Oil Field Development—has been the standard work on the subject for many years. It now is in its fourth edition. The volume on Oil Field Exploitation is in its third edition while Petroleum Production Economics is more recent. The* Oil Producer's Library *may be ordered through the Book Department of* WORLD PETROLEUM.

To prepare the present article Prof. Uren visited plants and research laboratories of five bit manufacturers in California and Texas.

Houston Research Laboratory of Hughes Tool Co. has 60,010 square feet of floor space. The building houses six laboratory sections. The drilling laboratory is equipped with a full-size 118-foot derrick designed to test bits under field conditions. (Photo courtesy of Hughes Tool Co.)

MORE than half a century has passed since the first oil well drilled with rotary equipment was completed. During this period, several hundred thousand wells have been drilled and the rotary equipment has been developed to the point where it can be successfully used under all conditions encountered in oil-field exploitation and to depths in excess of 22,000 feet. In 1955, 3,300 rotary rigs were employed in oil-and gas-well drilling operations in the United States. They drilled 51,300 wells, aggregating more than 200 million feet and costing more than $2½ billion. The well-drilling industry is "big business," and the manufacture of the equipment employed, the recruiting and training of skilled personnel and the annual provision of the necessary capital are among the most important problems confronting the modern petroleum and natural gas industries.

One would think that fifty years of development would have resulted in thoroughly standardized equipment and methods of well drilling, but apparently this is not the case. Important changes in drilling equipment, both in design and in the materials employed, are responsible for the improved performance that has been achieved during recent years. All parts of the rotary rig have shared in this development, but a large part of the credit for increased efficiency in well drilling is due to improvement in drilling bits. This article reviews progress in the design and manufacture of rotary bits and discusses conditions influencing their performance in well-drilling operations.

Types of Rotary Bits.—Several different types of bits have been developed for use in rotary drilling. They may be classified broadly into two groups: (1) drag bits; and (2) roller bits. Drag bits have no moving parts and accomplish excavation primarily by a scraping, gouging and chipping action of the cutting elements on the formation. The first rotary bits were of this type, best exemplified by the "fish-tail" bit, with two cutting edges formed on a slender blade. Later designs made use of three or four blades, arranged 120° or 90° apart, while for some purposes, a diamond-pointed bit was employed. More recently developed types of drag bits employ demountable cutter heads on which are formed cutting elements in the shape of prongs, so disposed as to attack the formation in the bottom of the well from different directions as the tool revolves.

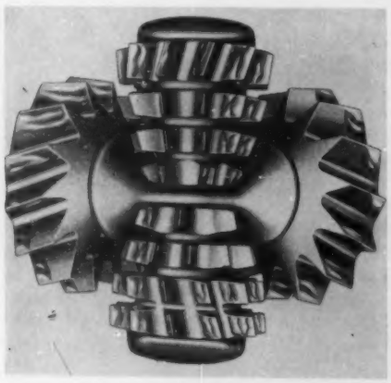
A roller bit is equipped with cutting elements mounted on supporting pins and bearings attached to the main body of the tool so that they rotate freely. The cutter elements roll on the bottom or against the wall of the well as the tool turns with the drill column. Sharp-edged teeth formed on the cutter elements are forced into the formation by the weight of the drill column and develop a chipping, gouging action. Bits of this type have a greater length of cutting edges than is possible for a drag bit, with resulting reduction in abrasive wear and greater drilled footage per bit.

Roller bits are of several types. An early type was the so-called "disc" bit in which two or more saucer-shaped discs are so mounted that their sharp edges are pressed against the formation on the bottom of the hole as the discs roll on their supporting pins. More efficient types of roller bits use cutting elements in the form of cones or cylinders, on the surfaces of which sharp teeth are formed. These so-called "rock bits" were originally designed primarily for drilling through hard formations not readily drilled by drag bits. However, as a result of many years of development, these bits are now available in a variety of styles that have attained wide use in soft as well as hard formations, and a large percentage of the footage drilled with modern rotary equipment is now drilled with rock bits.

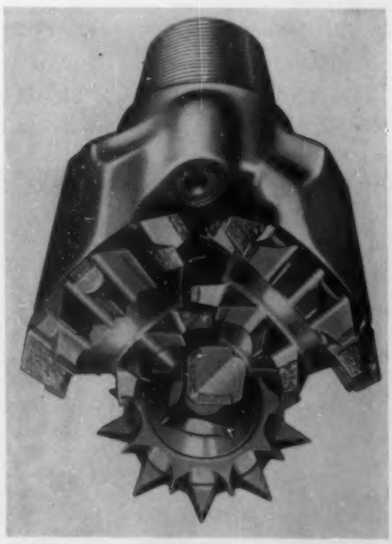
The basic features of cone and cross-roller bits were originally patented and their development was achieved largely by two of the principal bit manufacturers, but the original patents have lapsed and other manufacturers now compete in their man-

Drilling bit heat-treating facilities in the Whittier, Calif., plant of the Security Engineering Division, Dresser Industries.

Laboratory testing of drilling bit performance. (Photo courtesy of Security Eng. Div., Dresser Industries.)



Cross-section bit for soft formations. (Photo courtesy of Security Eng. Div., Dresser Industries.)



Jet-type tri-cone bit. (Photo courtesy Security Eng. Div., Dresser Industries.)

ufacture and sale. However, competition has been keen for this business, and more recent improvements in construction and design are covered by secondary patents that are presumably still valid.

Mechanical Auction of Rotary Bits—Any type of rotary bit can "make hole" only by the process of first embedding its cutting elements in the formation on bottom and then turning until the rock in the path of the cutting elements breaks free, so that the tool may turn before again penetrating the formation. Penetration is achieved by allowing a part of the weight of the heavy drill column to rest on the bit. Turning is accomplished by rotating the drill column at the surface, but the long, slender drill column provides a flexible connection between the rotary table and the bit that permits considerable torsional twist and longitudinal distortion, so that rotation of the bit on bottom does not necessarily correspond closely with that of the table at the surface. The elasticity of the drill column also permits a certain degree of impact action on the formation in the bottom of the well. In its effort to break free after the cutting elements have penetrated the formation, the bit chatters up and down as it turns. This effect is considered advantageous and is the expressed objective of a device for rotary-percussion drilling.

Due to distortion of the drill column, the drilling bit may operate eccentrically in the hole, leaning slightly one way and another, and thus drills a hole somewhat larger than the maximum diameter of the bit. A certain amount of eccentric action is desirable as it tends to maintain clearance for the bit, but extreme eccentricity may result in deflection of the well from its normal vertical course. This may be avoided by using sidewall reamers or a rubber stabilizer on the drill collar some distance above the bit. Deflection may also be avoided by using a long, heavy drill collar, somewhat larger in diameter than the drill pipe, and by so controlling the bit pressure that only the drill collar is under compressive stress.

For best performance in rotary bit operation, a suitable weight must be applied to force the cutting elements into the rock formation in the bottom of the well. Bit pressure is conveniently expressed in pounds per inch of bit diameter, and for roller bits this will range from 500 to 8,000 pounds, averaging perhaps, 4,000 pounds. Within limits, the rate of progress in drilling will increase directly with the weight imposed on the bit. However, the rate of rotation of the bit is also an important factor in determining drilling progress, and this must be proportioned to the bit pressure employed. High bit pressures require slower rates of rotation. In common practice, under normal conditions, the total weight applied will range between 15,000 and 55,000 pounds, while rotational speeds will range from 35 to 220 rpm.

The bit must be so designed and the equipment so operated that the drill cuttings are promptly lifted off bottom as they are formed. Cuttings must not be formed faster than they can be carried to the surface by the circulating fluid. This will be controlled largely by the rate of fluid circulation and by the pressure with which it is delivered against the bottom of the hole. The clearance spaces about the bit and between the cutting elements, through which the circulating fluid and entrained cuttings must rise toward the surface, should be of suitable cross-sectional area to provide a proper ascending velocity for the cuttings. Ascending velocities in the annular space between the drill column and the wall of the well will range between 50 and 300 feet per minute, the usual range being from 100 to 200 feet per minute. It is important that once lifted off bottom, the cuttings be kept moving toward the surface and are not allowed to accumulate in places where the ascending velocity may be unduly reduced by local enlargement of the hole.

Modern slush pumps are capable of circulating several hundred gallons of drilling fluid per minute under normal operating conditions, with pressures approximating 100 pounds per thousand feet of well depth. The fluid is jetted from the bit nozzles under high velocity, sweeping the drill cuttings promptly off bottom so that they do not impede the drilling action. Since the bit is revolving, the fluid assumes a swirling, helical path as it rises toward the surface. So great is the impact of the circulating fluid against the formation under the bit that it develops a powerful erosional effect which, in soft formations, may assist the bit in disintegrating the rock structure. Jet-type bits, recently developed to accentuate this effect, have nozzles so placed as to direct their fluid jets directly against the bottom of the hole under high velocity.

The rotary drill consumes power in two ways: first, in mechanical disintegration of the formation in its path; and secondly in hydraulically excavating the formation and lifting drill cuttings to the surface. Both consume large amounts of energy. The work done in literally tearing the rocky formation into small fragments, is directly proportional to the surface area of the cuttings. Breaking the formation into coarse chips consumes less energy than when the cuttings are in the form of small pulverized fragments. In addition to the energy consumed in disintegrating the formation, much energy is consumed in the form of heat, which must be conducted away by the circulating fluid.

A large part of the energy consumed in rotary drilling is expended in circulating drilling fluid down through the drill column and back to the surface through the annular space between the drill column and the wall of the well. Much of this is consumed in overcoming resistances to flow; a part is expended in erosional effects on the formation; and the balance, a substantial part of the total, is utilized in lifting drill cuttings from the bottom of the well to the surface. Lifting drill cuttings in this way is, at best, an inefficient process. The size and form of the cuttings will have

an important influence upon the efficiency with which they can be lifted by the circulating fluid. Small rock particles are lifted more efficiently than coarse cuttings. Flat chips are lifted more effectively than rounded, granular masses. It is apparent that the energy consumed in forming cuttings and in lifting them to the surface are opposing factors and that there must therefore be some optimum size of drill cuttings, under given conditions, that will result in a minimum over-all expenditure of energy. Breaking the material to either coarser or finer size will result in increased energy consumption. Theoretically, a drilling bit should be designed and operated to form cuttings of this optimum size, but practically, because of the complexity of the factors involved, it is difficult to determine just what this optimum size should be. There is some experimental evidence indicating that it is normally about ¼-in.

*Mechanical Design of Roller-Type Bits.**— To achieve maximum efficiency in excavation, a roller type of drilling bit must be so designed that as it revolves on the bottom of the well, it continually presents suitably placed cutting elements to the formation. These cutting elements should be so disposed that all parts of the rock surface shall have contact with them or some of them during each rotation of the tool. The paths of the cutting elements should not "track" each other and should overlap, so that no part of the rock surface will be left untouched. In the case of a cone bit, the cones are "mated," so that as they rotate the teeth on each cone turn in grooves between the teeth of adjacent cones.

The cutting elements that form the wall of the well must be carefully shaped so that they maintain full gage and do not tend to wedge the bit in the hole that it forms. Generally, the greater the number, depth and length of the teeth that can be provided on the cutting elements, the better will wear be distributed and the greater will be the footage obtained. However, the number of teeth that can be provided will be limited by the necessity for maintaining them of a size that will enable them to resist the stresses imposed. Above all else, a drilling bit must be rugged to withstand the destructive forces with which it must contend in service. The size, depth and pitch of the teeth will also be varied to accord with differences in the character of the formation in which the tool is designed to operate. Bits designed for hard formations will be provided with shallower teeth and more of them than bits designed to operate efficiently in soft formations.

The effects of variations in tooth spacing and design may be determined by rotating them under pressure on hard wood or soft cement blocks, thus developing test patterns from which one may predict the probable cutting action of the bit in actual service. The test pattern may be markedly altered by skewing the cutters slightly on their supporting pins, or by omitting or shortening an occasional tooth.

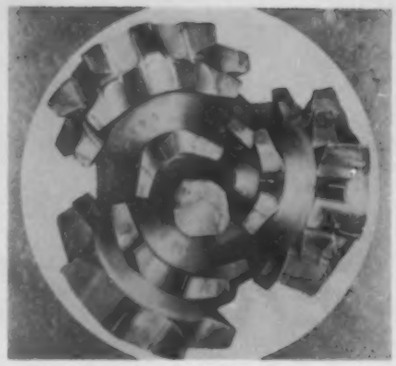
For drilling in very hard, brittle formations having high compressive strength, such as chert, dolomite and quartzite, where abrasive action is more effective than a chipping action, a special type of bit has been developed which has no cutting teeth. Instead, the cutters are studded with projecting hemispherically-shaped inserts of sintered tungsten carbide. Bits of this type have yielded footages in hard formations as great as 15 times that possible with bits of conventional type and three times as fast. In drilling with this type of bit, a high bit pressure and slow rate of rotation is employed.

The cutters of a roller-type bit are supported on roller or ball bearings set in machined raceways, so that they may rotate with minimum frictional resistance. Journal-type friction bearings are sometimes also used on the ends of the supporting pins. Because of the great weight imposed by the drill column, the bearings must be of adequate size and so positioned that they will successfully resist both longitudinal and thrust loading, which may at times be eccentrically applied. A popular type of cone bit uses roller bearings to support the heavy loads imposed by the weight of the drill column, while ball bearings take care of the lateral thrust loads and serve also to lock the cones on their supporting pins. The manner in which the cutting elements are supported will also be important in avoiding distortion under extreme loading. Bearings that are so disposed as to provide two different, widely-separated points of support are superior to single-line bearing designs that permit cantilever effects on the bearing pins.

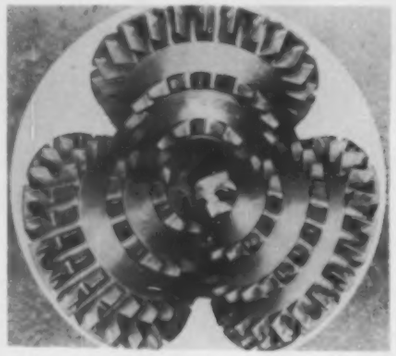
Metallurgy plays an important role in modern rotary bit design and manufacture. Because of the rugged service required, the cutting elements are drop forgings of special alloy steels, carefully selected and heat-treated to withstand abrasive wear and shock loads. Most manufacturers use a nickel-molybdenum steel (4815) containing two percent of nickel, carefully heat-treated to control the grain structure of the metal. Bearing raceways are machined and precision-ground. The roller and ball bearings are of a special tool steel alloy, heat-treated for maximum wear and precision-ground. The teeth and other parts of the cutting elements that develop contact with the rock formation are hard-faced to withstand abrasive wear.

Tungsten carbide is a preferred material for hard-facing drilling tools and special methods have been devised for applying and bonding the hard-facing alloy to the underlying steel surfaces. Usually the tungsten carbide is applied in the form of a flaky powder, supported in a matrix of fusion metal applied to the wearing surfaces with an oxyacetylene torch, but other technics are also employed. A method which

(*Continued on page* 70)



Tri-cone bit for fast drilling in soft formations. (Photo courtesy of Hughes Tool Co.)



Tri-cone bit for hard rock drilling. Tooth design is for maximum chipping and crushing, minimum tearing-scraping. (Photo courtesy of Hughes Tool Co.)

Bit for extremely hard, abrasive formations. Sintered tungsten carbide buttons give a chipping and crushing action. (Photo courtesy of Hughes Tool Co.)

Component parts of the cross roller sub-assembly, before assembly of a rock bit. (Photo courtesy of Reed Roller Bit Co.)

* Inasmuch as a large percentage of the footage drilled in present-day practice is by roller-type bits, this section will be devoted entirely to the design and construction of bits of this type.

Barge loaded with workover truck and perforating control car enroute to offshore well site. (Photo courtesy of Humble Oil and Refining Co.)

Humble uses onshore techniques and equipment to reduce the cost of recompleting a well eight miles out in the Gulf of Mexico.

OFFSHORE WORKOVER

HUMBLE Oil and Refining Co. has adapted onshore equipment and techniques to the job of working over offshore wells. In its first experiment in this direction, Humble loaded a workover truck with its auxiliary equipment and supplies on a barge. The barge was towed to the well platform and anchored alongside until the 10-day job was completed. As a result of the use of onshore equipment the workover was done at a saving of 85% from original estimates.

Over a year ago Humble put into service a truck designed by company research engineers to do all necessary workover jobs on permanent completion type oil or gas wells. It was this multi-purpose unit which was driven aboard the barge. With it went a station wagon housing instruments and cable reels for gun perforation operations.

The workover truck is powered by a 150 hp diesel engine which propels the vehicle and drives the main pump. An auxiliary 32 hp gasoline engine is provided for the wire lines and hydraulic equipment. The truck carries a cement storage bin and water tanks which double as cement mixing tanks. Storage space is provided in various compartments for all tools, fittings, blowout preventers and other equipment needed for a workover.

Main control center for the truck is located on the deck where the operator can observe wellhead equipment and personnel as well as the instruments showing pressures while circulating water, mud or cement.

The gasoline engine operates a vane-type hydraulic motor that controls the drum reels giving a smooth flow of power for wire line and cable work. An automatic bypass valve can be adjusted to prevent excessive pull on the line in case of a tool hanging up in the well. The same hydraulic system pumps water from the pit to the truck and drives the hoist used to pull tubing.

Humble's first offshore workover was eight miles out from Grand Isle. The well was one of six drilled from the one platform. It was directionally drilled with a liner set in the deviated hole. Despite this handicap it was found possible to use wire line tools.

Declining pressure in the well was the first indication of trouble. When the pressure decline became critical the well was recompleted by cementing off old perforations and reperforating at a higher level.

Humble began developing permanent completion methods a half dozen years ago in an effort to reduce completion and recompletion cost. Since 1953 all offshore wells drilled by the company have been completed by the "permanent" method.

Permanent completions envision the installation of wellhead equipment and tubing only once. This is done before the drilling rig is moved away. After rig removal the well is perforated, tested and cemented with wire line tools run through a lubricator mounted on the well head. The techniques employed were made possible by the development of special tools such as small perforating guns which can be run through the tubing but which are powerful enough to perforate the casing and cement.

Other special equipment was developed to permit squeeze cementing, acidizing and sand working through temporary tubing. Artificial lift devices were redesigned to fit the operation.

Recently the technique has been extended to dual completions through parallel tubing as small as 1½ inches in diameter run in a 5½-inch casing. Previously permanent dual completions had been successful with a single tubing to serve both producing zones. It had been found possible to conduct dual zone servicing operations such as cementing, reperforating, well stimulation, sand removal and exclusion, and artificial lift repair.

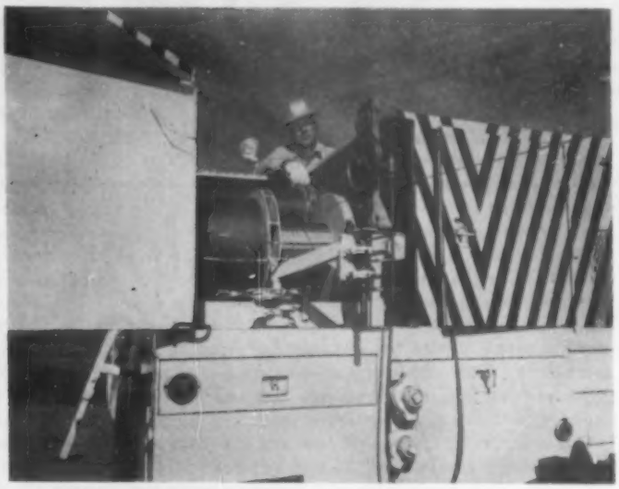
The use of parallel tubing in 5½-inch casing is made possible by continued development by the industry of special tools of minimum diameter. Rod pumps, hydraulic pumps and gas lift valves are being used successfully in such wells with the result that production from each zone can be isolated and one zone reworked without disturbing the other. Retrievable production tubes have been devised for wire line removal to facilitate reworking either upper or lower zones.

Experience with slim hole wells and with small diameter production tubing has shown that adequate volumes of fluid can be lifted to meet well allowables. Drilling, completion, production and recompletion costs all are reduced by the new techniques. END

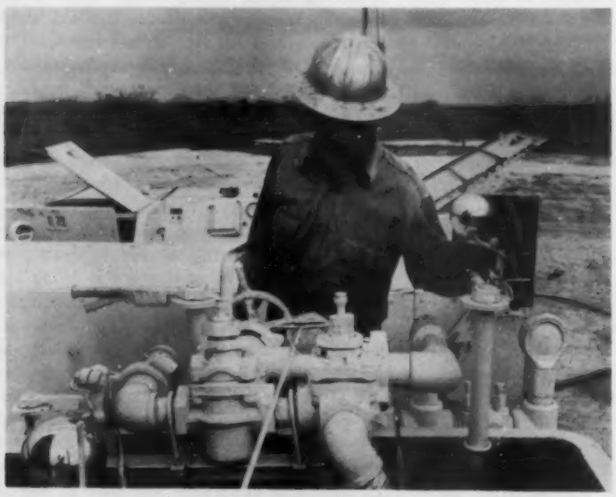
Workover barge tied up alongside the Humble platform from which six producing wells were drilled.

Wellhead lubricator through which workover tools were lowered to cement off old perforations and reperforate.

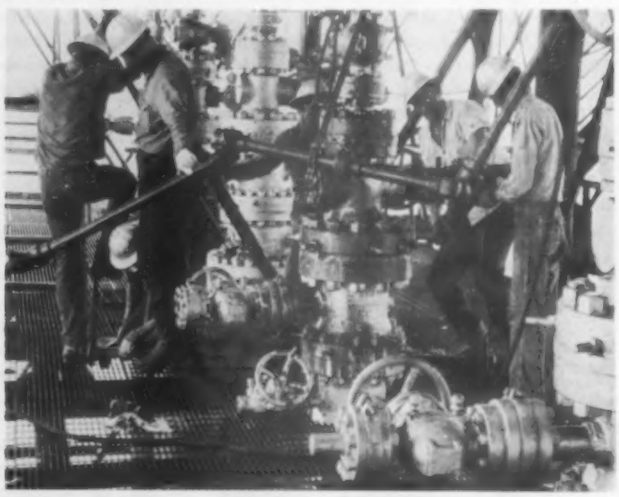
Workover truck with station wagon carrying instruments to aid in gun perforating. Operator has mike to communicate with cable reel operator on truck.



Three spools permit variety of operations. A single level winding guide serves all three spools.



Control center on deck of workover truck from which operator can keep close check on all pumping operations.



Wellhead equipment on offshore platform from which six wells were drilled. (All photos courtesy of Humble Oil and Refinery Co.)

Electric Drives for Drilling Rigs

By E. E. Childress*

THE electric drive drilling rig is not new. As far back as the '20's, some rigs were used where the noise of conventional drilling engines was not acceptable. The controls of these early rigs were cumbersome, complicated and expensive, and consequently they did not achieve great popularity.

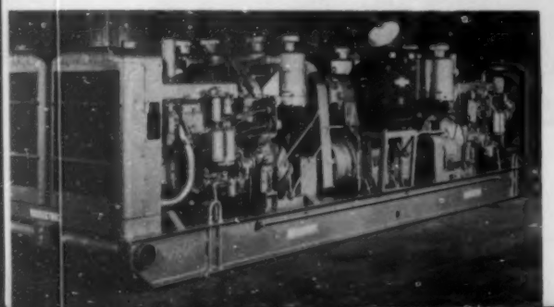
As transmission designs improved and better drilling engines became available the mechanical drive drilling rig came into its own and electric drive became an insignificant part of the total market. A little later, mill type industrial motors and generators similar to those used in steel mills were tried and a few rigs were sold using this type of equipment. However, initial cost was quite high and drilling crews were unfamiliar with the maintenance requirements. With the advent of fluid couplings and torque convertors, the demand for electric drive rigs virtually ceased.

Recently, the increase in barge and offshore drilling have revived interest in electric drive rigs. Very large rigs were required to handle the deep drilling. Furthermore, in the past two years, relatively low cost motors and generators suitable for drilling rig service became available.

The purpose of this paper is to take up some of the "pros and cons" of both electric and internal combustion engine drives as well as to clear up some of the questions associated with engine electric drive for drilling rigs. It is not intended that the discussions on advantages or disadvantages be construed as a rule by which one can assume that either arrangement can be more effective for all drilling rig purposes.

*Chief Engineer, Stewart and Stevenson Services, Inc., Houston.

Skidmounted unitized diesel electric power unit consisting of two 250 hp General Motors diesels connected with heavy duty traction type DC generator. For 1,000 hp units, four diesels are arranged on a common base to power two generators.



Both arrangements have their place in the drilling picture and the merits of both should be considered as they apply to the specific application before making a selection.

Utilization of available rig power where needed is a distinct advantage of engine electric drive power. By simple control arrangement the total power can be utilized to the best advantage. Since made through the use of multiple generator power units, the total power available can be divided as required for any combination of drilling and hoisting. Drilling speeds can be changed without affecting pump operation and any pump operation can be changed without affecting rotary speeds. Independent operation on any rig component gives flexibility not possible with mechanical rigs of the same horsepower. Speed control from zero to full speed can be accomplished on any component without changing the speed of the engines.

Dependability can be definitely assured by the use of a number of engine electric power units per rig with each unit consisting of one engine and multiple generators or multiple engine and generator combinations. Operational failure of an engine or generator does not mean failure of rig operation as in the case of failure of main power drive in a mechanical rig operation. Multiple motor drives on the drawworks and main pumps also provide safety and dependability since operation at reduced power can be maintained in the event of an electric motor failure. The construction and simplicity of controls, motors and generators and their construction of course, contributes greatly to their dependability. Elimination of clutches, free wheeling sprockets and sheaves and power transfer compounds and the use of simple chain drives gives engine electric rig power units a definite advantage for dependable operation over straight mechanical or hydraulic combination rig drives.

Maintenance costs with electric drive are usually much lower and the length of time between engine overhauls is much greater than with the same make engines on a mechanically driven rig. This is true because the engines can be operated constantly at their most favorable speeds without the necessity for long idling periods, lugging down, or frequent accelerating. Engines on an electric drive do not take the "bearing" which they are subjected to on a mechanical rig.

A simple illustration of this advantage, familiar to almost anyone operating drilling rigs, can be noted in the operation of the constant speed, AC electric generator sets used on most mechanically powered rigs. In most cases the auxiliary engines on the generator sets usually get less attention than the main engines, yet give less trouble and operate throughout long periods of service with a minimum of adjustments or repairs.

Often, especially in the case of offshore rigs, the arrangement or manipulation of machinery to fit existing or available space can be a factor of great importance. With diesel or gas engine electric drive, small, compact electric motors can be used for driving the drawworks, mud pumps, rotary, etc. and the main power plant can be located wherever there is space available. This is very simple and inexpensive from the standpoint of rigging up and installation inasmuch as the main requirement is simply to string up cables. On an offshore rig platform or mobile unit the saving in construction costs of a few square feet can actually mean a reduction of thousands of dollars.

On a land rig the flexibility of arrangement of the power with electric drive often permits economical mounting of the equipment on trailers reducing rig up and moving time.

After considering the many advantages of electric drive, it may be difficult to understand why electric drive is not used more widely, so it is well to examine the disadvantages that have in the past limited the use of electric drive:

The first and most important disadvantage has been, of course, higher initial cost. Now, however, with the use of high volume production line components and simple control systems such as have been recently introduced, the cost picture is more favorable. Current costs are only slightly higher than a good mechanical drive system and it is entirely possible that the savings effected in lower cost drawworks requirements as well as in the sub-structure requirements often cause the completed rig to be less expensive than mechanical drive when all factors are considered.

It is possible today to buy an excellent engine electric drive system complete with either diesel or gas engines, generators, motors, controllers and all necessary fabrication for less than $100 per hp. At this price, electric drive becomes a very major contender for rigs of 1,000 hp and more as well as smaller trailer mounted rigs.

The users' lack of knowledge of electrical equipment is a serious psychological disadvantage that cannot be overlooked. Generally speaking, tool pushers, drillers and roughnecks understand mechanical drive and know how to use it and maintain it. These same men have little understanding of electricity and usually are not qualified to do anything more than the simplest routine maintenance. This disadvantage, however, is more psychological than factual with today's simpler and more fool-proof control systems.

The lack of service has been another drawback to electric drive; however, as more electric drive equipment is being put into service, service facilities are comparable to those that now exist for mechanical drive and as the psychological fear of the electric drive wears off, many heretofore "disbelievers" in engine electric drive for drilling rigs will have to admit that some present-day engine electric arrangements offer actual advantages from the standpoint of simplicity and ease of maintenance.

END

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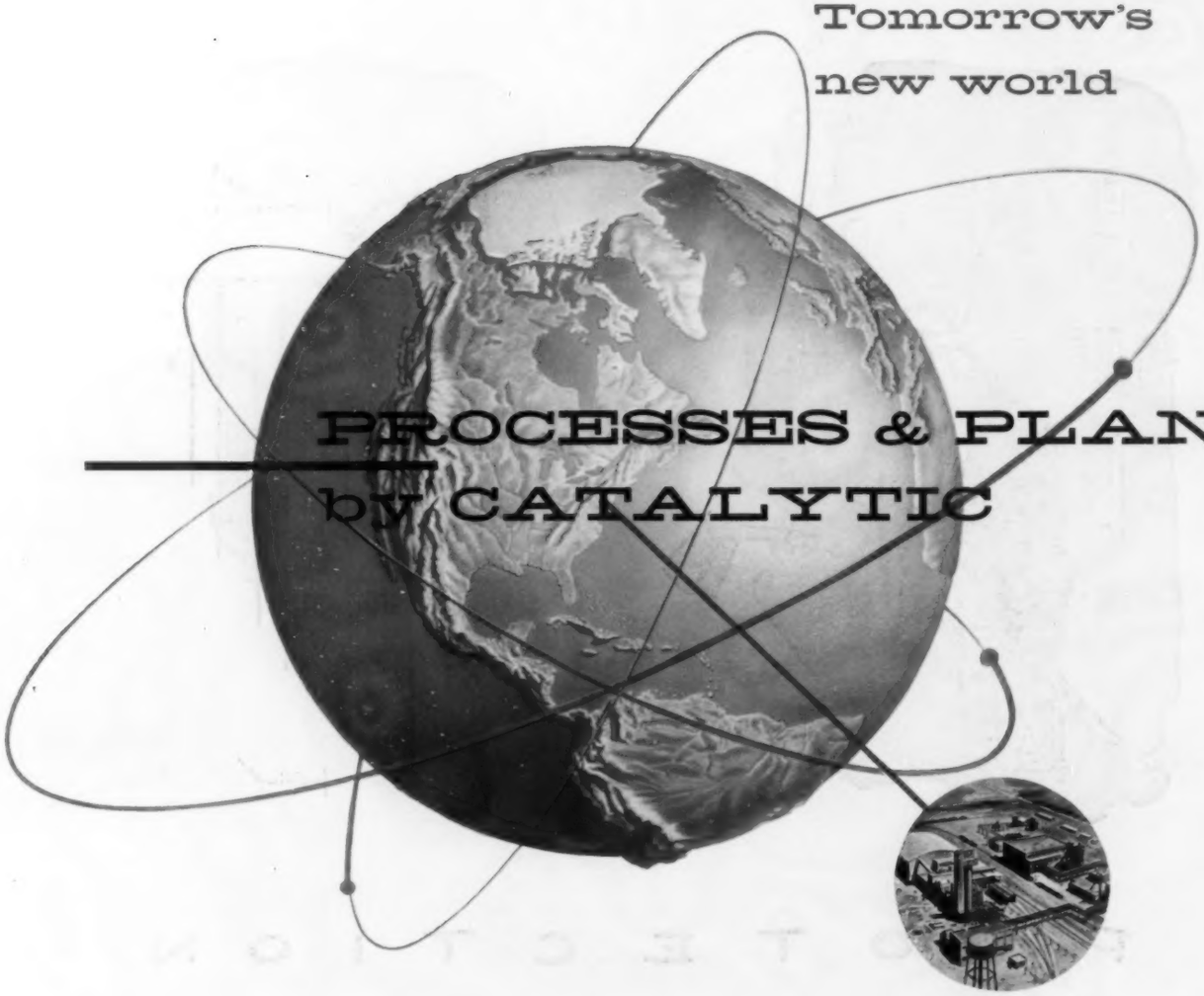

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Two schools of thought are developing in the design of mobile offshore drilling barges in the Gulf of Mexico. The recently launched 3-legged Scorpion and the S55 are the latest examples of each type—fixed column and movable spud.

MOBILE DRILLING BARGE DESIGN

By James W. Calvert

BACK during the planning stage, someone looked at a drawing of LeTourneau's floating island being designed as an offshore oil drilling platform for the Zapata Off-Shore Co., and remarked that it resembled Scorpio, eighth sign of the Zodiac.

The name seemed appropriate and on March 20 the three-legged, nine million-pound vessel was christened Scorpion in ceremonies at Galveston, Texas. Two days later it was towed to sea to begin its first drilling assignment for Standard Oil Co. of Texas in 46 feet of water off the Texas coast near Port Aransas.

On the same day christening ceremonies were held in New Orleans at Avondale Marine Ways for another offshore giant—California Co.'s drilling barge S-55, the largest structure of its kind ever built. That the completion of the two mobile drilling units on the same day represented both existing schools of thought in the growing offshore oil industry, is a coincidence.

Deep water mobile drilling units designed and built to date fall into two general categories. One is a barge upon which are mounted fixed columns supporting a completely self-contained drilling platform. On location the barge is submerged and thus becomes a foundation for the drilling structure. Such a vessel is California's S-55, as high as a ten-story building, designed to drill in water depths up to 75 feet.

The second type is the Scorpion mobile platform supported by spuds, or steel piling, The drilling platform itself is the vessel. On location the spuds are lowered and then driven into the floor of the ocean and later the platform is raised by mechanical means to the desired height for drilling. In one way the Scorpion is unique, however, even in an industry constantly marked by departures from the conventional in oil prospecting.

Industrialist-engineer LeTourneau conceived the idea for his offshore rig by observing an old-fashioned three-legged kitchen stool. A conventional chair or table will wobble on an uneven floor. Grandmother's three-legged stool held a firm and solid footing, no matter how uneven and worn her kitchen floor. A surveyors or photographers tripod will do the same; hence, reasoned designer LeTourneau, a three-legged structure should provide stable and level support regardless of the variations in the ocean floor level.

He calls the Scorpion the "most immovable and most mobile" structure ever built.

Basically, the structure is a giant pontoon barge consisting of three large tubes forming a "U" and joined by a center section, divided into compartments by bulkheads, decks, and water-tight doors. The hull is 150 feet long and 80 feet wide. The spud housings increase the overall length to 180 feet and the width to 150 feet. The hull is 20 feet deep and its draft, fully loaded, is 11 feet 6 inches.

There are three spuds, or legs, triangular in shape and built of open steel lattice work to afford minimum resistance to wave action. The bottom of each spud is a pontoon tank, 30 feet in diameter, and concave in shape to penetrate the ocean floor like a doughnut cutter. The spuds have been tested to support 8 million pounds, the approximate weight of the barge and drilling machinery.

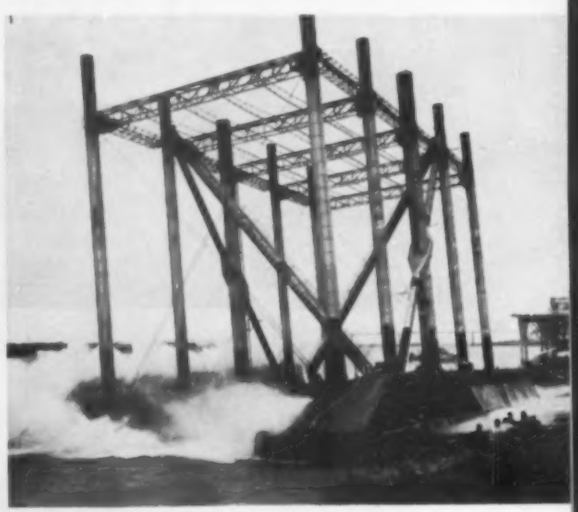
These legs operate in spud wells located outboard on the two sides and the after end of the platform. The legs are lowered and the barge itself elevated by means of LeTourneau-built electric gear motors, 21 to each leg, which in turn get their power from four AC generators powered by a bank of four Buda 8DAS-1125 diesel engines which are direct coupled to the generators.

The generators also supply power for two 250-ton-foot electric revolving deck cranes, for handling supplies and personnel on the drilling platform, and three electric winches.

The barge is towed to the drilling position with the spuds standing upright in their wells. On location the structure is first anchored and the spuds lowered to the ocean floor, penetrating from eight to twenty feet depending upon soil conditions. When the spuds are down the platform is then raised to the desired level for drilling and locked into place by integral motor-load brakes that set mechanically when electric power is cut off.

Drive pinions of the electric gearmotors mesh with gear tracks on the triangular

The California Company's newest submersible offshore drilling barge, S-55, recently completed at Avondale Marine Ways, New Orleans. The structure, as big as a 10-story building, is designed to drill in water up to 75 feet deep.



The S-55 is so big it had to be launched in sections. This shows the main center section being launched at Avondale. Later the main section was raised by means of the stabilizing pontoons and the two end sections welded to it.

One of the access tubes of the S-55 through which crewmen can reach the lower hull while submerged on a drilling location.

Main engine room of the Scorpion, *with the battery of four GM Model 6-110 diesel engines at left.*

legs. The motors activate one leg at a time, in increments of six inches, until the spuds are down and the platform raised. It takes approximately two hours to raise the platform to its maximum height, 140 feet above the pontoon bottoms.

When the structure is to be moved the electric gear motors are reversed, the platform is lowered until it is afloat and the spuds then drawn up into their wells. If necessary water can be jetted under pressure into the base of the pontoons to break away the mud.

LeTourneau said he designed the structure for multiple purposes, such as portable piers and for sulfur and coal mining. He said that a larger barge—one that can operate in 150 feet of water—is now in the drawing board stage.

The barge was built on the Mississippi River bank at LeTourneau's plant at Vicksburg, Miss., and literally "walked" to the water's edge by moving the legs up and down. Engineers estimated that the LeTourneau motors worked more in the two days required to launch the barge than they will be required in five years of normal operation offshore.

Outfitted in Galveston by the Oil Well Supply division of U. S. Steel Corp., the Farmers Marine and Copper Works of Galveston and Reagan Tool Equipment Co. of New Orleans, the *Scorpion* presents the most modern facilities for offshore oil and gas exploration.

A two-story air-conditioned house on the end of the structure provides comfortable living accommodations for the drilling crew, recreation and dining rooms, and offices. Although not completed at the time of the christening, a helicopter deck is to be built on top of the after spud housing.

Oilwell drilling equipment consists of No. 96 drawworks with 1,500 input horsepower, six hoisting speeds, three rotary speeds, two reverse speeds. There are 30 inches by 47 inches drum with LeBus grooving, 54 inches by 11 inches self energizing brakes, a 60-inch hydromatic brake, 45-inch dual Fawick high and ten drum clutches. All drawworks clutches are air controlled remotely.

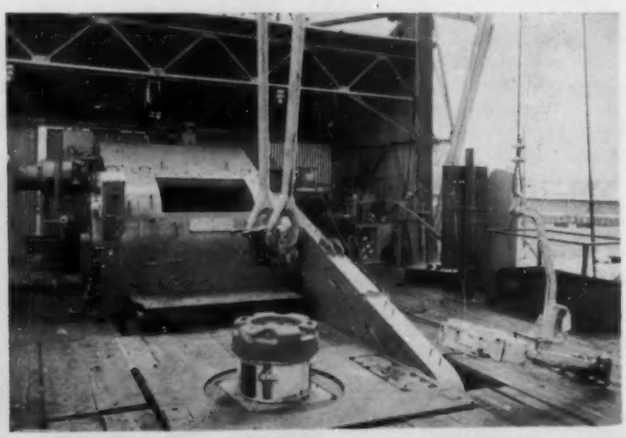
The main drive is an Oilwell No. 1500 four engine drive, with 28-inch dual Fawick master clutch, a 32-inch Fawick mater compounding clutch, 32-inch Fawick pump clutches, 1½-inch pitch quad compound chain and 1½-inch pitch sextuple pump driving chain.

The main engine compound consists of four GM Model 122403 6-110 twin diesel torque converter units, each rated at 400 continuous horsepower. They provide power for the drawworks and for two Oilwell Model 818-F mud pumps, rated 925 input horsepower at 65 rpm; bore and stroke are 8 inches by 18 inches, and displacement is 930 gpm at 65 rpm.

One unusual arrangement of the drilling machinery is the drawworks assembly located in the engine room, two decks below the rig floor and four feet off center to avoid interference with pipe or tools being brought in through the derrick V-door.

The driller can control all drilling opera-

Hull of the Scorpion *consists of three large tubes, two of them extending fore and aft and the third athwartship. The ends of the fore and aft tubes can be seen here. Storage and fuel and water is contained in the lower hull.*



The Scorpion's *derrick floor has the drillers console at right, with the catworks and rotary assembly in the center. The drawworks is four feet off center to allow for free movement of pipe and tools through the V-door.*

tions from his derrick-floor console, including the engine, pumps, automatic feed control, and hoisting below deck. However, a dual set of controls in the engine room provide maximum safety because the driller and engineer can override each other in case of emergencies.

The catworks in an Oilwell No. 52-T drawworks, especially adapted for catworks, coring and rotating operations, and powered with a GM model 6-110 torque converter diesel unit, identical to the main engines.

Other drilling equipment consists of Oilwell No. 500 crown block and No. 480 traveling block, 400-ton swivel, 350-ton rotary, and Lee C. Moore 140-foot derrick with 100 mile per hour wind load capacity and 1 million pound capacity.

Power for lighting and other auxiliaries is supplied by two Waukesha six NKDBS diesel engine sets, directly connected to two Electric Machinery 200 ks, AC 400/2230 volt 1,200 rpm Electric Machinery generators.

California Co.'s new barge S-55, designed by company engineer and the New Orleans firm of Friede and Goldman, Inc., is so big that it could not be launched from conventional building ways. Avondale first built the main hull member, launched it, then added two additional hull members by lifting the main central hull central and welding the side hull sections to it.

The submersible barge is 190 feet long, 150 feet wide, and the hull is 12 feet deep. Under tow the vessel has a draft of 6 feet 6 inches. The drilling platform is supported by ten fixed columns and the height from keel to the under side of the drilling platform is 90 feet.

Like other submersible units of this type, the S-55 is submerged on location by ballasting the lower barge. Stabilization is achieved by means of four recessed pontoons, operated hydraulically. Eight hydraulic rams, two for each pontoon, hold the stabilizing pontoons to the floor of the ocean while the main hull is being lowered or raised.

The lower hull provides storage area for fuel oil and drilling water, as well as machinery spaces for practically all of the equipment except for drilling and for power generation.

One feature of the S-55 is that it can drill four wells on one location, due to the movable crown block and rotary.

Living quarters for 84 men, recreation rooms and offices are air-conditioned.

To facilitate towing at sea, the designers provided for a rake on the bow of the vessel by the installation of a movable hinged section. During drilling operations this section is lowered to provide additional protection against scouring.

The S-55 is being operated by Noble Drilling Corp.

Both vessels were christened in the traditional manner. In New Orleans the honor of christening the S-55 went to Mrs. T. B. Flod, wife of a California Co. vice-president, and in Galveston the Scorpion was christened by Mrs. Wayne H. Dean, wife of the operations manager of Zapata Off-shore Co. Other Zapata officials present for the occasion were president George H. W. Bush, treasurer J. Hugh Liedtke, and chief engineer Hoyt S. Taylor.

A new concept in self-contained, movable offshore drilling equipment is now being tested off Cameron Parish, La.

John W. Mecom, Houston independent oil operator, has announced successful operations from a submersible drilling barge supported on a 1,400-ton floating dry dock, patterned after the navy repair vessels of World War II.

In operation, the dry dock picks up the drilling barge normally used on inland waters, carries it to any location in water from 10 to 40 feet deep, and then cradles it securely during drilling and completion operations. It is stated to have distinct advantages in mobility, flexibility of operation, and quick evacuation in the event of storm or emergency. In 90 minutes the operators can lift it from 30 feet of water and move to safety.

The $800,000 barge supporting dry dock was constructed by the Levingston shipyards in Orange and launched without fanfare more than a month ago. Mr. Mecom said he wanted to test it before making an announcement. The barge itself represents an investment of another $800,000 which with $300,000 worth of tugs and other auxiliary craft bring the total cost above the $2 million mark.

The seagoing dry dock is 220 feet long, 78 feet wide and has wing walls 48 feet high. It can move in 10 feet of water and has been approved by the American Bureau of Shipping for drilling in water up to 40 feet deep. The present test in Block 45 off Cameron Parish is in 29 feet of water.

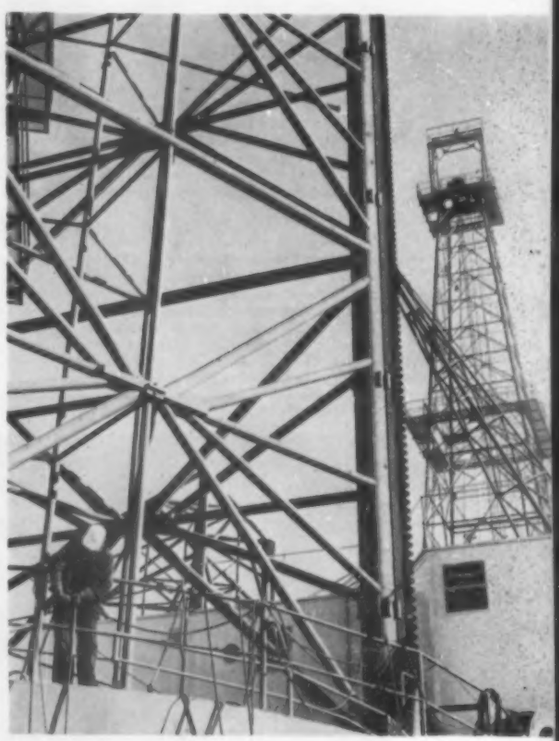
Constructed of heavy steel, the dry dock has 7/16th-inch bottom plates, 3/8th-inch steel on the sides and deck and 5/16th-inch plates on the work floor. Four high volume deep well pumps on each side can submerge the craft in less than an hour. Each pump has a capacity of 3,000 gallons per minute.

A two-foot skirt around the bottom of the dock enables it to dig into the Gulf floor and the weight of the vessel holds it in place. Oil or water can be carried in the wing tanks for either ballast or supplies.

The craft was named by Mr. Mecom after his old friend Ed Malloy, president of Levington, who built this and numerous other drilling barges and seagoing equipment for him. One previous attempt had been made to utilize this type of offshore craft, but the Mecom model is sufficiently improved and modified to be classed as an entirely new approach.

An additional advantage of Mecom's new offshore equipment is that it is completely salvageable. The barge can be used alone and its dry dock support can also be used as a dry dock repair base for offshore operating equipment. The dock's decks will accommodate barges capable of drilling from 10,000 to 16,000 feet, operators said. Barge living quarters on the present rig will hold 24 crewmen; there are mess halls, recreation areas and other essentials of modern offshore drilling operations. END

Zapata Offshore Company's three-legged floating island in her berth at Galveston, Texas. The drilling platform was designed and built by LeTorneau. In this photo the three triangular shaped spuds are resting on the floor of the bay and the hull is raised slightly above the water. The spuds are 140 feet in length, the same height as the Lee C. Moore derrick.



This close-up of one of the spuds shows the gear rack along the edge. Each of the three gears on the spud is powered by seven electric motors; and the platform is raised and lowered by a total of 63 such motors. This is the after spud, on top of which is to be constructed a helicopter landing platform.

Submarine core drilling from anchored vessels is supplementing offshore seismic work. Production thus far is from artificial islands, piers or onshore directional wells. First mobile drilling barge in the west will begin work soon.

California Tidelands Development

By L. P. Stockman

L. P. Stockman, author of the accompanying paper on California tidelands development, has written authoritatively about California petroleum industry problems and developments for more than three decades and is rated throughout the industry among the best informed on all phases of oil exploitation and utilization. His reportorial career began more than 32 years ago when he became affiliated with the Oil & Gas Journal *on the death of Charlie Gilman. When Mr. Gilman died, the* Journal *wired Les Stockman, asking him to pinch-hit until some permanent arrangement could be made for a full-time representative on the Pacific Coast. He continued to pinch-hit for over 20 years and upon his resignation in 1946 as California district editor of the* Journal *he had concluded the longest temporary affiliation on record. He subsequently joined* Petroleum World *as a contributing editor and at frequent intervals also contributes articles to* World Petroleum.

Mr. Stockman, a native of San Francisco, has long been a resident of Los Angeles. Except for 22 months in 1917-19 spent in an attempt to "make the world safe for democracy" he has had no interests outside the petroleum industry. For 16 years, his annual estimates of California hydrocarbon reserves have been generally accepted as sound and representative of existing conditions. For the past 10 years, these estimates have appeared exclusively in Petroleum World's *Annual Review number.*

As author of numerous technical articles, Mr. Stockman's pen has traced most of the California petroleum industry's greatest technical and engineering achievements from their inception. In the bibliography section of a state publication on Geologic Formations and Economic Development of the Oil and Gas Fields of California (Bull. 118, issued by the Division of Mines, California Dept. of Natural Resources) he has 73 citations, extending over a period of 12 years.

TIDELAND exploration in California differs greatly and is several years behind the Gulf Coast politically and in the scope of activities. This is because of public indifference and a questionable political philosophy on the part of past California legislatures.

A former governor, who was no friend of the oil industry, prevented an early solution to what has been found is a simple problem. It was not until 1955 that the legislature enacted remedial legislation that will ultimately permit exploratory work out in the Pacific Ocean off the California shore line. The present modern political concept is dominated by the demand for additional income by the state. Prospectors are asking that 75,000 acres of potentially productive tidelands be opened for bidding in 1956 so that general exploration may get under way in 1957. The anticipated high cash bonuses plus annual royalty income is a factor of great importance in the quest for additional income to balance out a billion-dollar budget.

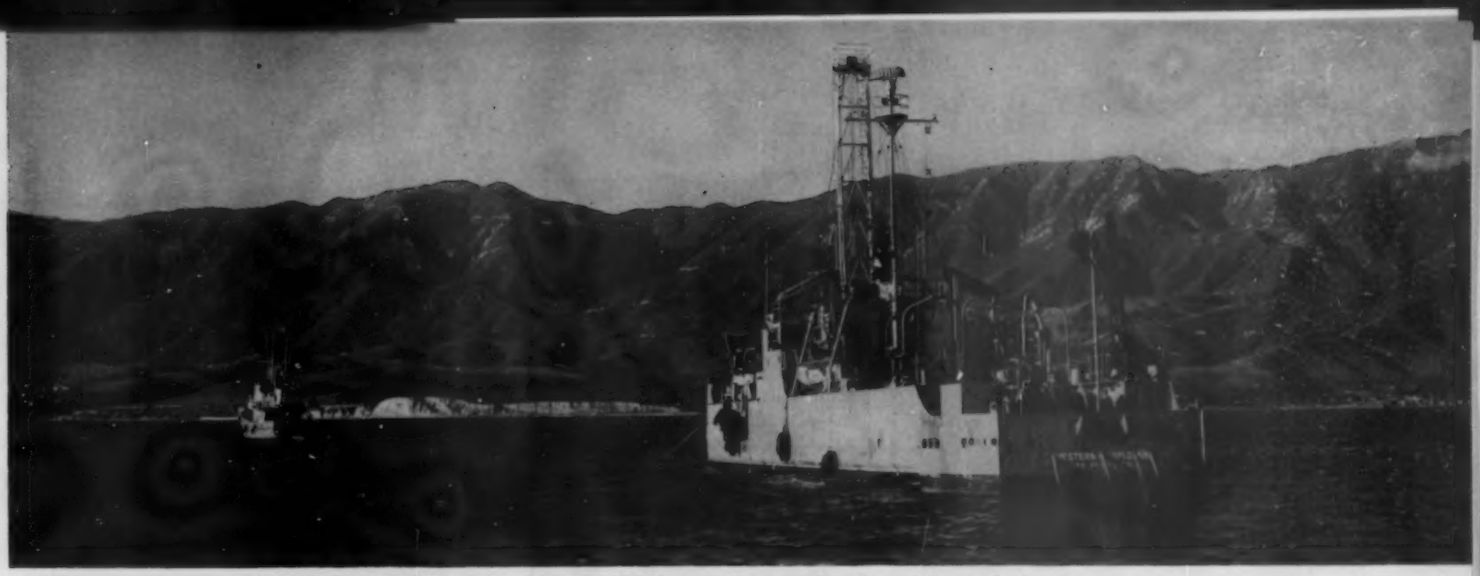
Present basic law is contained in the Cunningham-Shell Tidelands Act of 1955 which amended certain sections of the Public Resources Code relating to oil, natural gas and mineral leases of state lands. The law is not exactly what the California oil industry wanted but it will provide an opportunity for the first time to undertake exploration work and subsequent exploitation of any tideland discoveries off the California coast.

The State Lands Commission is charged with the responsibility of carrying out the rules and regulations contained in the Cunningham-Shell Tidelands Act and it is given complete independence of action and wide latitude in determining the amount of land selected for bidding and the determination of proper royalties. The Commission has done an outstanding job to date and will continue to meet the most exacting requirements. It is composed of Lt. Governor Harold J. Powers, Robert C. Kirkwood, state controller and John M. Peirce, director of finance and chairman of the State Lands Commission. Col. Rufus W. Putnam is the executive officer and Stuart J. Watson is assistant executive officer. Francis J. Hortig is mineral resources engineer and is doing a splendid job.

Prior to enactment of the Cunningham-Shell Tidelands Act, the industry had to locate wells on upland locations and prove drainage of a state-owned parcel before a lease could be executed. Consequently, practically all tideland development to date has been limited to exploitation of an oil pool that was discovered and produced in the upland area and later found beneath adjoining submerged tidelands. The drainage requirement has been eliminated in the new act and future tideland leases will be awarded to the highest cash bidder. This means sealed bids and not oral bids. The new tidelands act also corrected a long standing evil by requiring competitive bidding. Previously the littoral landowner was the only one who could secure a tideland lease because the law of trespass operated against anyone drilling a well over or under the land at the low tide line.

Leases executed by the State Lands Commission within a known geologic structure will command a royalty of not less than 16⅔% and incorporate a sliding scale commencing at not less than 16⅔%. The Commission has authority to establish the rate of future royalties on this type of lease and the top may go as high as 75% if the Commission so designates. On wildcat acreage, the royalty will be 12½% and the lease will go to the operator who offers the highest cash bonus.

The Cunningham-Shell Tidelands Act specifically authorizes the use of artificial drilling islands, platforms and drilling barges. Each may have certain advantages and this choice is to be made by the operator. Legality of artificially filled island drill sites for oil and gas operations was upheld in a three judge decision of California's third district court of appeals. The appellate court's ruling not only upheld the State Lands Commission's action in granting Richfield Oil Corp. a 1,150-acre off-



Standard Oil Co.'s Explorer, *a converted ISMA, being used as a drilling barge. It is completely equipped for drilling. (Photo by Tommy Amer for Standard Oil Co. of Calif.)*

shore drilling lease at Rincon in Ventura County but also had the effect of throwing out of court a lower court suit instituted to block the Richfield lease because, among other things, it did not own the littoral land. This decision also has the effect of validating the use of artificial drilling islands elsewhere along the coast, as provided in the Cunningham-Shell Tidelands Act of 1955. This decision is important also because this lease was the last issued prior to the effective date of the new tidelands act.

In addition to the Cunningham-Shell Tidelands Act, the 1955 legislature also enacted the so-called Ward Bill which, among other things, officially recognized the Conservation Committee of California Oil Producers as a voluntary group and places the stamp of approval on the Committee's recommendations of maximum efficient rates of production. The U.S. Attorney General attempted to prevent passage of this act because of its possible effect on an anti-trust action pending in California. These MER's are based on studies of the Conservation Committee's engineering board. Demand, the level of inventories and prevailing prices have no bearing on the findings of this engineering board or the fixing of MER's.

The status of the Conservation Committee of Oil Producers is mentioned at this time because it will establish maximum rates of production for any and all tideland wells provided the electorate defeats a controversial conservation bill which will be voted on at the 1956 general election.

The Ward statute places certain restrictions on the Conservation Committee. While that committee is authorized to make recommendations and producers may comply therewith, the Committee is required to deliver all such recommendations to the State Oil and Gas Supervisor and make available to him all of its records, reports and other pertinent data. The supervisor may either approve or disapprove the recommendations and is authorized to make his own recommendations if required. This law permits the state, through the Oil and Gas Supervisor, to make recommendations if there is a difference of opinion. Compliance is voluntary but most operators conform with established recommendations. Producers have the aid and assistance of both the Conservation Committee and the Oil and Gas Supervisor.

There are about 150 pools in California which are subject to MER recommendations. Some pools are small and others simply involve a top gas limitation. Since passage of the Ward Act there has been no conflict of engineering recommendations. The Conservation Committee of California Oil Producers consists of 30 members representing 30 districts. Members are elected annually by secret ballot and not more than one member of a company can serve. Expenses are borne by assessments based on the rate of production. Operators who pay their assessments represent 95% of the state's production.

The Continental Shelf, which will be subjected to extensive exploration beginning late this year or early in 1957, is very narrow on the California coast and the ocean floor deepens quite rapidly. It is not unusual to encounter ocean depths of 600 feet within five miles of the shore line. As a result, the width of potentially productive acreage is much smaller than tidelands in the Gulf Coast where comparatively shallow water is encountered 20 miles or more from shore. Topography of the Gulf Coast region is exceptionally flat whereas the California coast is extremely rugged. Structural features of both areas are a repetition of those found on land. In California these features consist of sharply folded anticlines with associated faulting and pinch-outs.

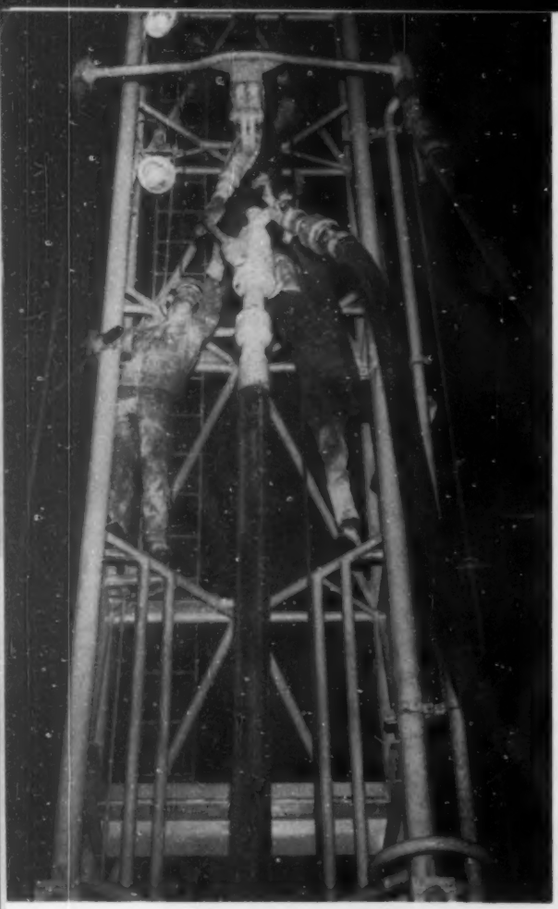
Leases issued by the State Lands Commission cover 17,649 acres at the present time. Previous to 1955, leases had been executed on 12,897 acres of tideland properties. During 1955, the Commission leased an additional 4,752 acres. This included 647 acres at Huntington Beach which brought the state $517,776 from Richfield Oil Co., Hancock Oil Co. and Signal Oil & Gas Co. as a joint bid. State leases 1549, 1550 and 1551 were executed for a total bid of $5,183,342.70. Richfield, Hancock and Signal Oil & Gas Co. drilled a test well on lease 1551 at Huntington Beach but it failed to show any favorable indications and drilling was suspended at 7,221 feet. The well was subsequently redrilled from 606 feet and reached a new depth of 7,686 feet. It was abandoned on April 10, 1956, and the gamble failed to pay off. There is a possibility that some further drilling may be done on this lease at a later date.

Monterey Oil Co. will take delivery of a new DeLong drilling barge in July and will employ it to drill a test well on state permit 1550, which consists of 1,280 acres located one mile from shore. This lease is too far seaward to be reached by wells surfaced in the littoral or upland area. Consequently the barge will be employed. The DeLong barge is quite similar to the type in use in the Gulf Coast area and is capable of drilling in 90 feet of water. It is of the mobile type and will be anchored and supported by caisson legs. This will mark the first use of this type of barge in California.

Monterey Oil Co., Humble Oil & Refg. Co. and Seaboard Oil Corp. paid $1,333,533.35 as a cash bonus for this lease. This is at the rate of $1,041.82 per acre. It is a joint undertaking of the three operators and this will probably be the pattern of all future bidding because of the high cash bonus required.

State lease 1549, which is also held by the same concerns, is located between lease 1550 and the tide line. Lease 1549 extends out for a distance of one mile and contains 1,355 acres. For this lease the successful bidders paid a cash bonus of $3,333,533.35 or at the rate of $2,460.16 per acre. Two unsuccessful tests have been drilled on this lease. The first well was drilled to 8,711 feet and redrilled to 7,163 feet. The second well reached a depth of 10,886 feet and will be redrilled. Neither well showed any encouragement and while they both were located on opposite sides of the lease they may not have succeeded in reaching their respective objectives.

The outcome of exploration work with the drilling barge on lease 1549 may effect



Traveling block on Explorer *is welded to crossarm to prevent whipping as vessel rolls and pitches. (Photo by Tommy Amer for Standard Oil Co. of Calif.)*

the future status of both lease 1549 and 1550. The cash bonus for the two leases totals $4,667,066.70 to which must be added the cost of the drilling barge, the cost of two dry holes and the cost of drilling additional tests. Tideland development comes high and even if production is developed it will take a lot of oil to liquidate costs to date and pay the cost of pipe lines and storage tanks.

Generally, tideland development in California up to the present has been from wells surfaced in the uplands and whipstocked or slanted into adjacent tidelands by directional drilling. Exceptions to the general rule are at Belmont, Elwood and Rincon. At Belmont, Monterey Oil Co. and its partner, The Texas Co., has built a drilling island about 1½ miles seaward of the tide line and at Elwood and Rincon considerable drilling has been done from piers. As a matter of fact, production of the Elwood tidelands greatly exceeds the amount of oil and gas produced from the uplands. The major part of the Elwood structure was buried beneath the tidelands.

Richfield Oil Corp. will soon award a contract for construction of a drilling island on a recently acquired tideland lease off the Rincon field in Ventura County. This operator drilled several core holes from a drilling barge before calling for construction bids. One of these wells drilled down into the first oil pool and produced for a short time before being killed. The hole was filled with cement and casing cut off at the bottom of the ocean. The company was not equipped to complete the well and handle production without interfering with construction of the island. This one well indicated Richfield's tideland lease will be productive and will justify the expenditure of approximately $2 million to build the island. This lease involving 1,150 acres was granted by the State Lands Commission before enactment of the Cunningham-Shell Tidelands Act and did not involve any cash payment. The company's bid specified a high royalty, based on actual production. As production increases, the royalty also rises and reaches a high of approximately 80%.

Richfield's projected drilling island at Rincon will measure 260 by 180 feet and be capable of accommodating 70 wells. Depth of water at this point approximates 45 feet. No unusual problems are expected to be encountered as engineers have the advantage of having details of Monterey Oil Co.'s drilling island at Belmont. Oil and gas lines to the shore will be laid after production has been developed. A water line will also be necessary as well as a telephone cable. Nearest point of the island to the shore will be a little over a mile but the number of producing wells along the coast in the uplands may make the route slightly longer. The island will contain drilling equipment, mud tanks, blowout preventers, generators, oil and gas separators and other equipment generally used in conventional drilling. It will have a cement deck and be of one level operation. Extreme precautions against any and all hazards will be of prime importance because a blowout would be an extremely costly item. Richfield is an excellent operator and this, together with the probability that most of the gas head has long since been dissipated, almost precludes such an eventuality. Complete specifications of the island are not available at present.

California tidelands are divided into two classes, i.e., those leases made with the State of California and those made with a municipality. In the latter classification are leases at West Newport, Torrance-Redondo and in the Wilmington fields. The most successful of these is the Long Beach-owned tidelands in the Wilmington field. The Long Beach Harbor Commissioners granted a number of leases to various operators before the City of Long Beach decided it would like to develop its own tidelands without putting up any money or taking any of the risks. Accordingly, the Long Beach Oil Development Co. was organized and has operated successfully for a number of years.

This company, which is in reality operating for the City of Long Beach, is owned by Signal Oil & Gas Co., Hancock Oil Co. and Standard Oil Co. Each owns a one-third interest and the city's interest is protected by a comparatively high royalty. Upon completion of the term of the lease, all wells become the property of the City of Long Beach. Voters, however, recently gave the city council authority to renew existing leases if they decided it was advantageous to do so. Richfield Oil Corp is paying the highest royalty in the field on a lease taken from the Long Beach Harbor Board. The City of Long Beach receives about 85% of net receipts after drilling and operating costs are deducted. The remainder is administrative costs. The advantage to Richfield Oil Corp. is that the company gets control of all production developed which it processes at its Watson refinery. It is believed this is the highest royalty paid by any operator in the state although the projected royalty at Rincon may be equally as high.

Tideland development in California, like Topsy, just grew and reached maturity in 1955. Earliest work was at Carpinteria but in recent years tideland exploration and exploitation started at Elwood where operators built drilling piers out at right angles to the coastline. Later a major pier was built by General Petroleum Corp. at Rincon to facilitate exploitation of the Rincon tidelands. These piers are still in use despite the fact that a Jap submarine fired several shots at the Elwood installations. At Huntington Beach, operators reached out into the tideland by the use of whipstocks and by tilting the rotary tables. A great number of wells reached the tidelands in this manner before the State stepped in and negotiated leases with operators having tideland wells in the field. All wells were surveyed and the actual location of each was ascertained. Later state leases were made with Southwest Exploration Co. which owned property in fee in the uplands area paralleling the ocean front. This company, owned one-third by Hancock Oil Co. and two-thirds by Signal Oil & Gas Co., has been exceptionally successful in its exploration and exploitation work. Subsequently additional leases were awarded Southwest Exploration Co. and Signal Oil & Gas Co. because no other operator had upland property from which to drill.

The extensive leases of Southwest Exploration Co. at Huntington Beach are perhaps the most interesting tideland development in California up to the present. This company starts directional drilling from upland drilling sites at 250-300 feet and attains a high angle of 76°. Wells reach out approximately 12,000 feet offshore and when the bit reaches the pay it is almost horizontal. The Jones sand reaches its largest thickness offshore. No data has been released about directional drilling at Belmont where Monterey Oil Co. and The Texas Co. are exploiting the tideland accumulation from a drilling island. It is known, however, that one of the wells drilled from the upland before construction of the drilling island was so flat that the drill pipe would not drop down the hole. Contrary to the law of gravity, it had to be pushed down the hole. This well reached out to within about 1,000 feet of the existing artificial drilling island and it is still producing today at about the same rate it showed on completion several years ago. Two productive

pools have been found at Belmont. One is believed to be the Ford pool and the other may be the equivalent of the Ranger or upper Terminal. It has not been definitely determined whether the Belmont accumulation is a component part of the Wilmington field or whether it is a separate accumulation. The squabble between the City of Long Beach and the State over finances has brought tideland development to almost a standstill.

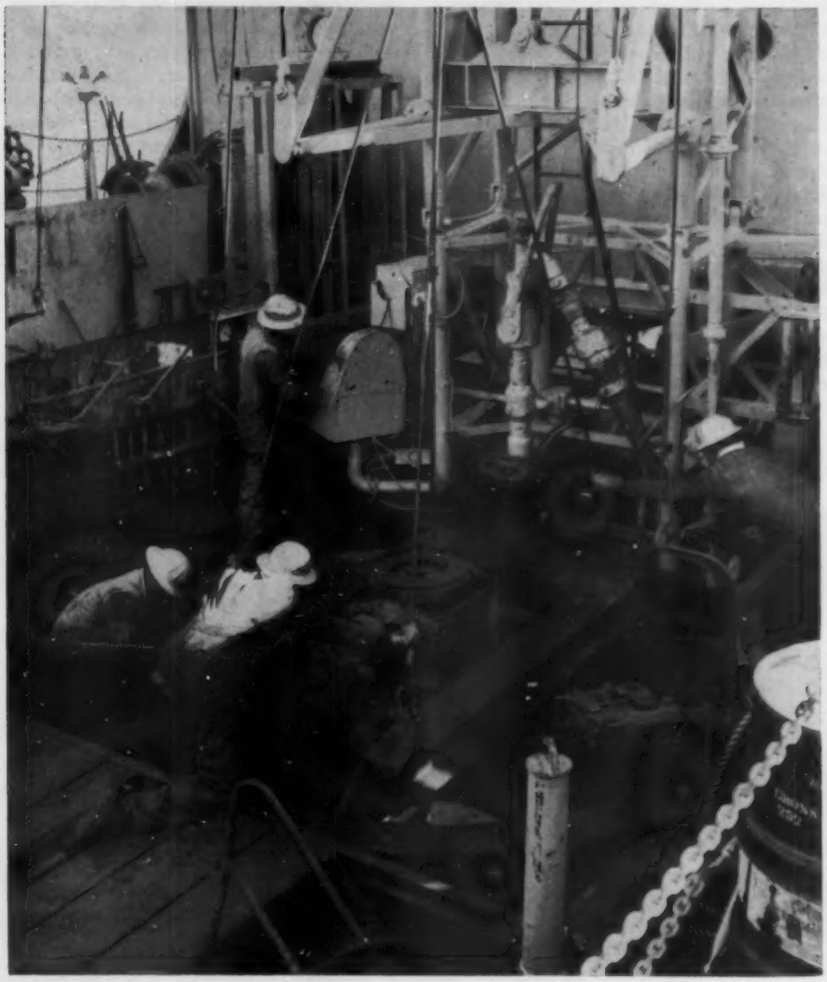
All major companies in California have or are now doing submarine reconnaissance work to find promising areas for future work. This includes mapping, seismic studies and the drilling of shallow core holes. This work has been going on intermittently for several years. Early seismic work and shallow core holes failed to give a sufficiently detailed look at some areas, probably because the survey covered too much of an area. First submarine seismic work was undertaken in California in 1943. The primary purpose of this survey was to investigate possible extensions of known structures and outline additional features along known trends. It was not too successful.

The objective of current programs involving core holes is primarily to get a complete stratigraphic picture and a better outlook on promising oil bearing structures. Core holes usually go to about 500 feet but in one case a core hole was drilled to 2,500 feet and another went to about 6,000 feet from a drilling barge. These relatively deeper core holes were drilled off the Rincon field in Ventura County.

Standard Oil Co. of California is using a 204-foot converted LSM which weighs 700 tons, has a 34-foot beam and draws seven feet of water. A 55-foot drilling mast has been mounted just forward of the bridge. It is the first vessel on the Pacific Coast to be equipped for full drilling operations. Several additional similarly-equipped barges are now operating in Pacific waters or will be in use at an early date. A 10-foot diameter hole was cut completely through the hull of Standard's LSM forward of the bridge to mark a new development. The vessel was given structural reinforcement and a torque converter was added to the diesel hoisting engines. This is the first time in California that a barge has been equipped to permit drilling from inside the vessel. The previous method was to run drill pipe into the ocean floor from equipment placed on the side of the vessel.

Blowout preventer is lowered through hole in center of Explorer. Hydraulic lines permit remote control. (Photo by Tommy Amer for Standard Oil Co. of Calif.)

Rock and roll of Standard of California's Explorer is offset by rotary table. Hydraulic power is used to drive rotary table and pipe tongs. (Photo by Tommy Amer for Standard Oil Co. of Calif.)



The rotary table on Standard's drilling barge is gimbal-mounted to offset the vessel's rolling motion and special joints of pipe with vertical slip sections compensate for the heave of the vessel. Six such joints with 24-inch telescoping sections allow 12 feet of up and down slack which keeps the drilling bit on the bottom of the hole while the ship rides the waves. The barge is anchored by two 1½-inch cables from the bow and two 1½-inch cables from the stern.

In order to conform with Coast Guard regulations that no projection can be left on the ocean floor, a special tool has been designed to remove the well-head assembly and casing below the ocean bottom. Use of radar buoys enables the drilling vessel to anchor so precisely that if the ship has to leave an operation to escape a storm she can return to within 15 feet of her original position. The ship's radar can pick out the three buoys used for an accurate position up to 20 miles.

New drilling techniques have made it possible to drill in relatively deep water by using anchored barges similar to Standard's converted LSM with probable improvements. If deep drilling is anticipated the barge must be so equipped. This is especially important because a large part of California's tidelands are submerged in areas heretofore regarded as out of reach

because of deep water. It is now believed that exploratory wells can be drilled in 200 feet of water with little difficulty. The only apparent limitation on the depth of water in which a hole can be drilled is the length of the anchor chains and the ability to maintain an equilibrium.

The terms "tideland development" and/or "tideland exploration" are many times applied quite loosely in California and have become almost synonymous. In discussing this subject intelligently, however, it is necessary to differentiate between the two types of operation. In the strictest sense, California tideland exploration should not include presently productive tidelands that are adjacent to the shore line and being exploited by directionally drilled wells from upland locations. Tideland exploration should also not include operations at Belmont, where Monterey Oil Co. and The Texas Co. have built a drilling island to reach what is believed to be a part of the Long Beach Harbor section of the Wilmington field. Primarily this operation did not come as a result of tideland exploration because the accumulation was found by a directionally drilled well from the upland.

Without exception all fields adjacent to tide water and containing submerged tidelands thus far discovered have been the result of wildcat exploration in the uplands and were not found as a result of tideland exploration. The real test will come when the State Lands Commission offers wildcat acreage for leasing in submerged areas. The importance of tideland exploration in the future remains to be determined by actual drilling. Some are inclined to place great emphasis on the potential possibilities of California tidelands while others are inclined to minimize probabilities on the assumption that prospectors are too confident and have not yet found a new field in the tideland areas. All agree, however, that tideland exploration in California will be a costly problem, especially because of the varying depths of water. It is logical to assume that for the immediate future prospectors will concentrate their tideland activities relatively close to shore.

Howard Pyle, president of Monterey Oil Co., at a recent meeting of the Pacific Coast District of API expressed his opinion that the offshore areas offer the last probable large source of new oil in California. He believes that the rate of oil discovery will be controlled by the state and local leasing policies, by the continuing solution of operating problems and by industry's ability to control the high costs of doing business offshore. Mr. Pyle also pointed out that "so far, practically all offshore oil has been found by directionally drilling from shore. This type of exploration will continue, but its limitations will make it necessary to adopt a new concept or a new approach to offshore exploration."

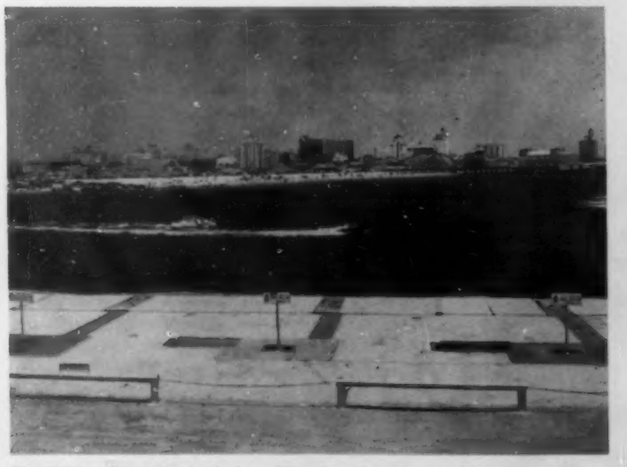
This was one of the most popular papers at the regional meeting because of the interest and possibility of extensive early work. Mr. Pyle is optimistic that, in spite of difficulties, "oil will be found and produced at rates which together with onshore production will meet California's ever mounting petroleum requirements for many years to come. Favorable geological structures should certainly be checked by core drilling. If there is then any question about the occurrence of oil or the configuration and extent of structure, stratigraphic and structural test wells should be drilled. Three great oil producing basins, Santa Maria, Santa Barbara-Ventura and Los Angeles, adjoin the Southern California coastline. These basins unquestionably extend offshore and show favorable potentialities."

Bert Mattei, president of Honolulu Oil Corp., on the other hand, recently told the California Petroleum Press Club that he thought the importance of California's tideland area was greatly overrated and did not contain the vast amount of oil that has been generally assumed. There may be an economic level somewhere along the line because of the tremendous cost involved and the highly competitive struggle for reserves.

Governor Goodwin J. Knight, on April 13, 1956, signed legislation which will ultimately give the State of California $120 million in cash and a share in all future revenues from oil and gas production in the Long Beach tidelands. This legislative bill, approved in the closing hours of the 1956 legislature session, ends a dispute over $171 million in accumulated royalties held and impounded by the City of Long Beach. The compromise settlement when consummated will be along the lines of the State Supreme Court decision in the Mallon case which awarded the state one-half of the oil income and all of the revenue from natural gas.

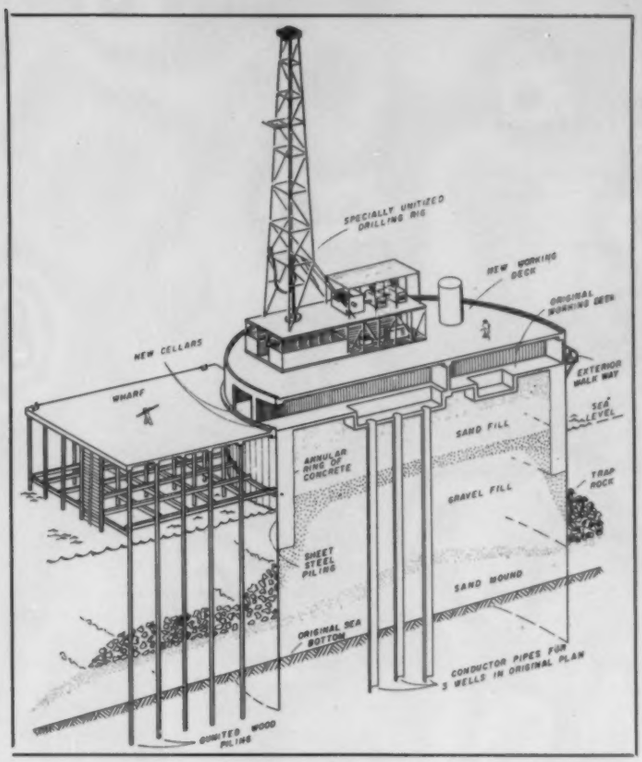
The City of Long Beach holds the key to this problem and may delay taking advantage of the compromise until all details have been worked out. The city has considerable remedial work to do around the harbor and this was considered when the bill was in legislative committee. The Mallon suit questioned the city's right to use the proceeds from tideland income for the acquisition of park lands and other municipal purposes. The state grant to the City of Long Beach stipulated that all revenues had to be spent for harbor improvement. Long Beach accumulated its large amount of money by impounding revenues during the long battle with the federal government to get a quit claim. It is interesting to note that the state did the same thing to Long Beach that the federal government did to the various states in past years. It has denied to the City of Long Beach the use of revenues accruing from its tideland. The court did not warn the city that it must limit expenditures to harbor development. It ruled by a four to three vote that the city must relinquish most of its tideland fund. It is another example that political entanglements are injurious to the oil industry.

Tideland exploration now under way at the extreme west end of the Torrance field

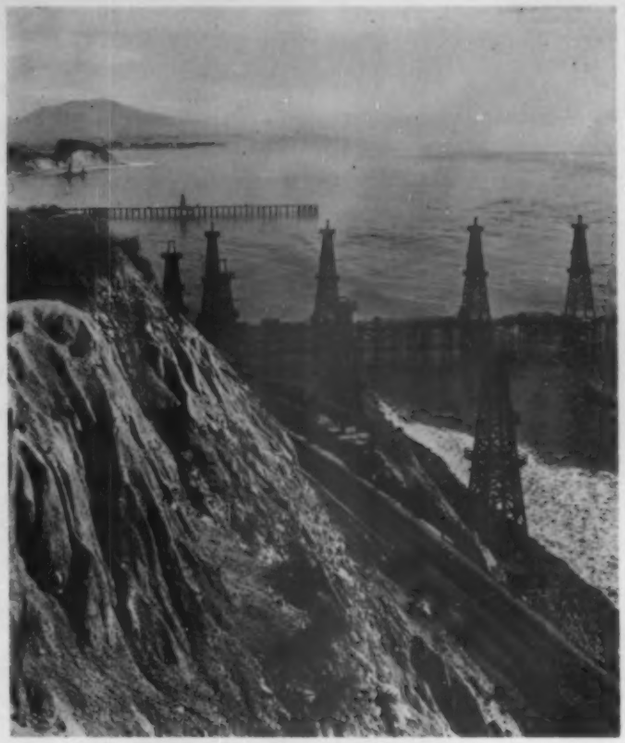


Pier "A" at Long Beach Harbor. All wellhead equipment below ground.

This is a sample of the pumping units, installed in a cement vault underground and covered by a sheet steel mat, which will be used at Redondo Beach.



Schematic cross-section of Monterey Oil Co. drilling island.



Early offshore wells in California were drilled from piers.

where it plunges beneath the ocean reflects the execution of a development contract between the City of Redondo and Signal Oil & Gas Co. This is a joint undertaking of Signal Oil & Gas Co., Artnell Oil & Gas Co. and Reserve Oil and Gas Co. The contract is for a period of 35 years and as long thereafter as commercial production is developed. The City of Redondo was prevented from leasing its properties because of provisions contained in the 1915 grant but nothing precluded execution of a development contract.

The City of Redondo will receive a royalty ranging from 18 to 50% depending upon the amount of production developed. Drilling has been prohibited in Redondo for many years but last year at a special election the people voted to permit this special operation but to retain the city's ban elsewhere in the area. Operators have recently negotiated contracts with property owners who have property within the City of Redondo and especially parcels close to the east line of Redondo. It has been found advantageous to locate wells in Torrance and whipstock wells beneath the Redondo parcels. These community leases have been found to contain commercial oil which is being captured from an area where no drilling can be done.

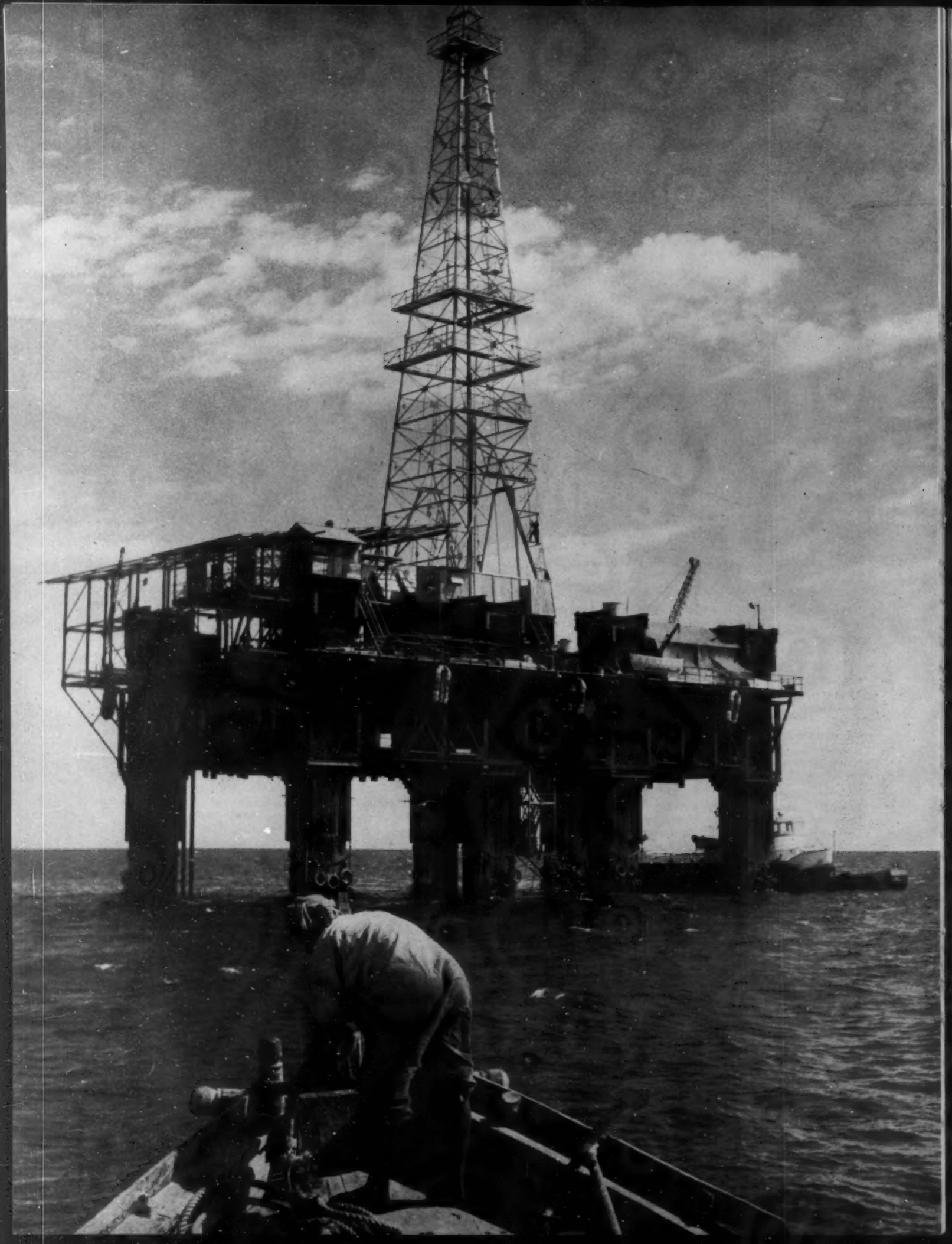
The Torrance field is an open anticline of considerable areal extent but no drilling has heretofore been done in the Redondo area where the anticline appeared to plunge into the ocean. Engineering data indicated, however, that the Torrance anticline was rising in the Redondo area and this has been verified on the basis of the first two wells. Subsurface conditions offshore remain to be determined by preliminary drilling. There is a deep submarine canyon off Redondo where the floor of the ocean drops from 45 feet to about 1,500 feet. This canyon is at a right angle to the shore line and suggests the possible existence of a deep seated fault. Exploratory work at Redondo which is being done from upland locations is just getting under way and it may be several months before final conclusions are reached. This development contract is mutually advantageous to the City of Redondo and the operators. All primary wells will be whipstocked seaward to provide data for additional drilling. A total of six wells will be drilled from a central drilling area located in close proximity to the tide line. The first well, which was completed as a small but commercial producer, was carried 500 feet seaward and the second well will show a deviation of 1,500 to 2,000 feet.

Because tideland exploitation is being conducted from an artificial drilling island, operations at Belmont southeast of Long Beach are of outstanding importance. This is the first drilling island used in Southern California for exploratory work and it was originally expected to be expanded if commercial production resulted from drilling operations. High installation costs, however, resulted in a change of plans. Originally, the drilling island of Monterey Oil Co. and The Texas Co. at Belmont was 75 feet in diameter with an adjoining wharf. As a result of experience to date and some excellent engineering studies, preparations have been made to drill 70 wells on the original island which was designed to hold six wells.

Encouraged by the results of the preliminary experiment in unprecedentedly close spacing of directionally drilled wells, engineers began an extensive analysis of the entire island set-up with the idea of determining how many wells could be accommodated. Having arrived at a figure for minimum spacing, the next problem was to provide sufficient cellar space. It was found advantageous to build the cellars upward and elevate from the original working floor and create a new working level at the top of these new cellar walls about nine feet above the original floor. No delay was encountered because conductor pipes were driven in the east side of the island while drilling operations continued on the west side. The drilling rig was then moved over to the east side and this permitted installation of conductors on the west side. By proceeding in this manner, Monterey Oil Co. was able to continue drilling and production activities which would have been shut down if the drilling island was to be expanded and enlarged.

As soon as all conductor pipes had been driven, an annular ring was dug in the sand with which the upper section of the drilling island was filled. This annular tunnel was continued to the top level of the intermediate layer of gravel. Pipes were then driven through the filled area into the gravel and cement was then pumped in. This filled the interstices in the gravel and

(Continued on page 98)



QATAR

Qatar produced 41.5 million barrels of oil in 1955 and has set a target of 62 million barrels per year from the Dukhan field. Shell is drilling its second offshore wildcat test in the Persian Gulf.

By E. Lawson Lomax

PROBABLY less attention has been paid by the general public to the production of crude petroleum in this small Sheikhdom in the Middle East and yet its income from this source is higher per capita than any other of the countries or Sheikhdoms which comprise the Middle East.

It is a small, mainly arid, peninsula which juts like a finger into the waters of the Persian Gulf, between the Island of Bahrain and the Trucial Coast. Its normal population is estimated as being 25,000 at the utmost, and yet it is a very hive of activity in the production and export of petroleum.

Prior to World War II three wells had been drilled in the Dukhan field, but these were plugged during the war and commercial production only started in 1949 with a production that year of 621,632 barrels.

Since that time it has gradually increased, reaching 41,503,922 barrels in 1955, and now the future production program visualizes a gradual build up to an annual production of about 62 million barrels. This demands ample dispatch and loading facilities for this amount of crude. The present facilities are therefore being extended with this end in view.

Headquarters of the producing company, Qatar Petroleum Co. Ltd., an associate of the Iraq Petroleum Co.'s group, were originally located at Dukhan, close to the producing field, with the loading terminal at Umm Said on the other side of the peninsula, but during the past two years a portion of the administration and the auxiliary services, such as the mechanical and electrical engineering departments etc., have been removed to Umm Said, while the services, peculiar to oil production, i.e. drilling, geological, geophysical, reservoir engineering, generally speaking the fields department, remain at Dukhan.

With a prospective production life of many years in front of it, the company has built permanent towns including employee living and recreational accommodation in both locations.

Shell is drilling its second wildcat off the Qatar coast, employing a rig based on experience in Lake Maracaibo and the Gulf of Mexico. (Photo courtesy of Shell.)

The capital of Qatar is Doha, in fact, apart from the oil company's locations, it is really the only town on the peninsula.

Three years ago, this was a typical small Arab town, with narrow, unpaved streets which during dry weather—the normal weather in Qatar—were inches in fine dust, but after rain were quagmires of mud.

The larger portion of this old town now has disappeared along with its old buildings and the old dusty narrow lanes have given way to wide asphalted roads.

New buildings have literally sprung up in what were the outskirts of the old town, a shopping center has been formed, an electrical power station has been built by the British firm of Brush, a water distillation plant has been installed for the production of potable water. Incidentally, the cost of electrical power and water to the consumer is high by most standards, electricity cost being equivalent to about four pence per unit.

Out of the income which he derives from petroleum, the ruler of Qatar has built schools and a hospital. Another much larger hospital is in course of construction.

The ruler has also developed a scheme by which he gives, free of charge, a plot of land close to the town to each of his subjects who wishes to erect a home.

It would appear that this action has been a very popular one, judging from the number of plots of this kind which one sees marked out, round and about the town.

For the recipient of the plot, it is a definite indication that he, at least, is benefitting directly from the development of the petroleum industry in his country.

As with other countries of the Middle East, Qatar is becoming to a certain extent the hunting ground of "get-rich-quick" individuals, and evidences of that are prominent, particularly in Doha, the capital, where local shop-keepers, contractors, and Qatari business men generally are reaping a rich harvest.

Qatar is one of the smallest of the Sheikhdoms in which petroleum is being produced in commercial quantities and naturally the number of the interested parties in this rush for a share of the booty is smaller than in the larger Sheikhdoms, but the evidences of this sudden increase in wealth are of the same order i.e. the large number of modern American cars one sees, crowding the restricted spaces in the town; the great variation in their colors, and the large amount of chromium plating. It is said that the Middle East in general is the most receptive market for anything new in the luxury world, whether it can be put to use or not, and the goods displayed in the shops seem to support this statement; as everywhere can be seen, electrical cookers, washing machines, cleaners, elaborate gramaphones and radio receivers, expensive cameras, watches and jewelry, in fact every evidence of the availability of hard cash. Under similar conditions of sudden wealth, these countries of the Middle East, are probably acting in a manner very little different to what a country to the West would react, at least on the surface; but the question then arises as to the effect this wealth will have on the future development of the country and its peoples.

As mentioned earlier, Qatar is a small, mainly arid peninsula jutting into the Persian Gulf. Apart from its riches in petroleum, it has little or nothing which can bring commercial prosperity to it. In addition, owing to its type of territory and almost complete lack of fresh water, it would appear to be completely unsuitable for agricultural development even to provide sustenance for its present small population.

This population in the normal course is bound to increase and in view of the provisions being made for health services, education etc. this increment will be greater in future than in the past, and the question therefore arises as to its future prospects in the country, and what will happen to it when the oil reserves are exhausted, as they inevitably must be, sooner or later.

There is evidence that the present pro-

ducing field, under modern methods of reservoir control may have a life of some 50 years, the estimated reserves at present being 1,500 million barrels and so the finance of the country should be stable for that length of time, and its income, when the first burst of spending has exhausted itself, should be sufficient to keep its population well above the starvation line.

With regard to the financial future of Qatar, its ruler is apparently acting under good advice, and is regularly utilizing a portion of the annual income for the establishment of a capital fund. This portion is invested in securities external to the country, which in years to come, when the income from oil production may cease or gradually diminish, will provide a source of income for the provision of the necessities of life to the population which, can not be produced internally.

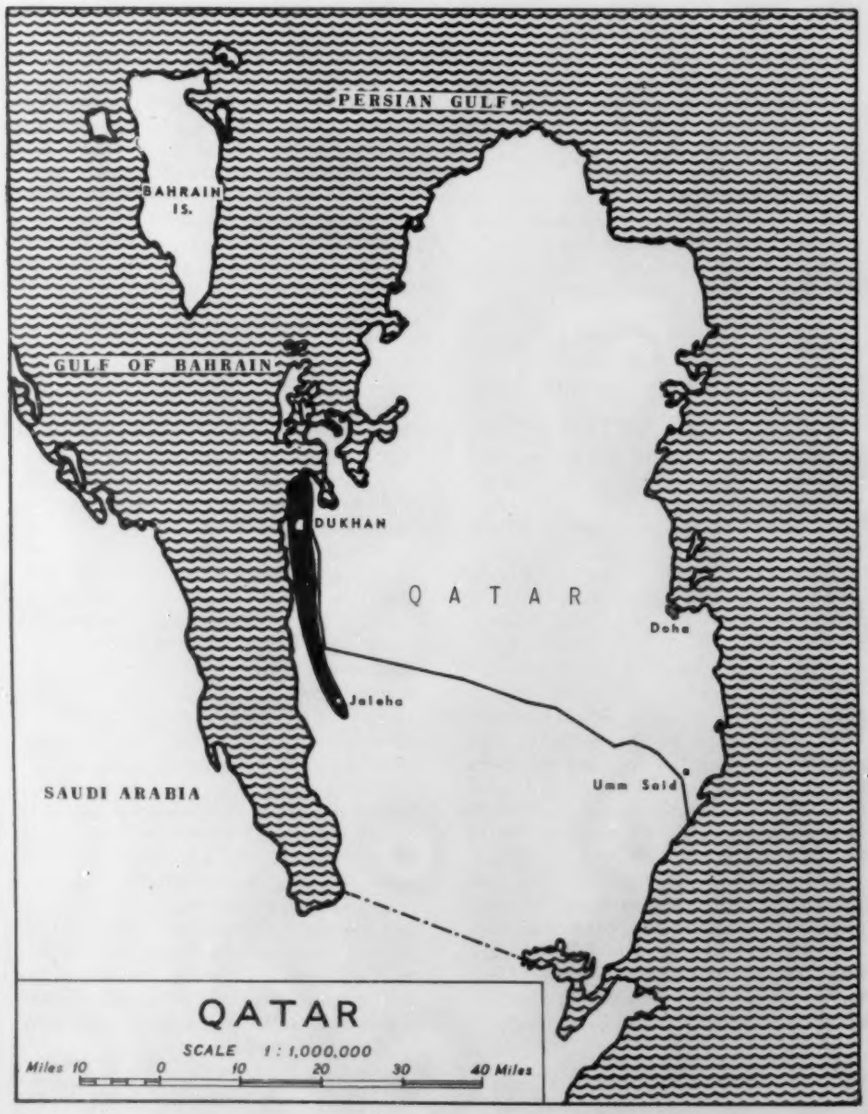
Dukhan Field, Qatar. At time of writing, 53 wells in all have been completed in the Dukhan field, and drilling is continuing with one drilling crew and one rigging up crew; the two crews leapfrogging, i.e. the rigging up crew take charge of the rig, its removal to a new location and spudding in after the completion of a well.

The drilling crew, after completion of a well, moves on to the next location where the rig is then ready.

At time of writing No. 54 well is drilling and No. 55 rigged up awaiting the drilling crew.

In the completed wells there are 40 producing wells, nine producing in No. 3 limestone and 31 producing in No. 4 limestone. One well, No. 35, is producing in the Uwainat zone. The non-producing wells are mainly used as observation wells.

There are three de-gassing stations on the field, "Khatiyah," the first station to be built in 1949, the second "Fahahil," completed in 1954 and "Jaleha" completed December 29 1955.



Fahahil station has a capacity of 70,000 b/d. It has two single outlying separators, located conveniently to certain wells, which are 150 feet long by 4 feet 6 inches diam., with a rated working pressure of 1,000 psi maximum. At the degassing station there are two separators, similar in size and rated working pressure to the outlying separators, one of these works at the same separating pressure of 650 psi as the outlying separators, while the other is used as a secondary stage separator working at 175 psi. There are then three separators 100 feet long by 4 feet 6 inches diam. working at 75, 25 and 10 psi respectively with a final stage in 100 feet diameter by 48 feet high fixed roof storage tanks.

Jaleha station, the latest completed, has a capacity of 30,000 b/d, it has four 75 feet long by 4 feet 6 inches diam. separators working at 600, 130, 38 and 10 psi respectively with final degassing in a 50 feet diam. by 48 feet high tank.

Khatiyah station, the first degassing station to be built is at present being completely revamped to work on similar lines to the Fahahil station as the area has been drilled up and full knowledge of it obtained. The present separators are being lengthened by the addition of a new section. When these alterations are completed the station will have a rated capacity of 85,000 b/d.

A program of instrumentation is being carried out at these degassing stations which it is hoped will eventually lead to them being automatically controlled, and thus reduce labor requirements.

When the alterations to the degassing stations are completed they will have a total capacity of 185,000 b/d, which will then enable the target of 62 million barrels of crude production to be approached.

A new deep test well is being considered in this field to go down to 15-16,000 feet.

The storage capacity at the terminal tank farm has been raised to a total of just over two million barrels, giving a capacity available for shipment of 1.8 million barrels in 16 tanks.

Loading Lines. Until recently two sea loading lines have been sufficient to enable production to be loaded into tankers, but, again, in preparation for increase in the production target to 62 million barrels a third loading line was installed in the middle of March 1956.

This loading line consists of 3,500 feet of 24-inch line pipe with half inch walls, weighing 125.49 lbs. per foot. The line was welded on shore, parallel to the water line, each weld being gamma-ray tested, and was then doped with Wailes Dove Bitumastic tar enamel Grade A and wrapped with fiberglass. Expendable magnesium anodes are attached as a form of cathodic protection.

After the line was wrapped and doped the ends were sealed, and towing hooks fixed. The line was then rolled down to the sea at low water, and when the tide rose it was just buoyant enough to float. The sea-end was then towed out to sea to a point at which it was straight and in direct

Aligned ready for sinking, Umm Said offshore loading line. (Photo courtesy of Qatar Petroleum Co. Ltd.)

Temporary fitting for Qatar sea line to be replaced later by a permanent fitting to enable two 10-inch sea-loading hoses to be connected to end of 24-inch line, Umm Said. (Photo courtesy of Qatar Petroleum Co. Ltd.)

line between buoys pre-laid to mark its ultimate position. The towing was then reversed and it was towed back shoreward to a point where it could be attached to hauling tackle anchored on the shore and then hauled into position at the shore manifold. The towing end was then removed and the line connected to the manifold.

The line is anchored at the shore end by concrete anchors and clamps to a depth of nine feet.

The towing block at the sea end was then removed and the line sunk, after which the sea-end of the line was attached by divers to the Y piece having two connections for 10-inch hose used for attachment to tankers' lines.

Topping Plant. To supply the local requirements of Qatar for motor spirit, kerosine and diesel or gas oil, a small Foster Wheeler atmospheric distillation unit of 600 barrels per stream day capacity with the necessary auxiliary pumps, heat exchangers and intermediate and storage tanks has been installed.

The motor spirit is caustic soda washed and then leaded up to requirements. The kerosine fraction only requires a soda wash to sweeten it.

The residue from the topping plant is returned to crude storage.

Commissariat. The quality of the commissariat at Dukhan, was noticeable on a previous visit, and the same standard at least is maintained and that is a very high one. Prices of tinned goods seemed to vary very little from prices for the same goods in English shops.

Activities of the Shell Group in Qatar. The Shell group has established an organization at Doha, Qatar, under the name of the Shell Co. of Qatar Ltd.

This organization has been formed to work a concession from the ruler of Qatar to explore the territorial waters of Qatar for petroleum.

A large amount of work has already been done in this direction combined with a large expenditure which has already risen to the neighborhood of £7 million.

A permanent camp with living quarters for families and single men has been set up and a combined club house and restaurant established.

Workshops for maintenance, repairs, etc. have also been built, with office accommodation for managerial, technical and clerical staff.

A special form of drilling platform for under water drilling has been built based on experience gained by other Shell organizations at Lake Maracaibo, Venezuela, and also at Seria, off the coast of Borneo.

This consists of a number of hollow rectangular legs which rest on the sea-bed and which are braced together to form a stable frame work on which platforms for the derrick, draw-works, sludge pumps and motors necessary for the operation of drilling can be built. This form of structure also enables living quarters to be built into it for the drilling crew and also a landing platform for the use of helicopters.

An essential for the successful employment of such a structure is a firm foundation on the sea-bed and so a survey of that is necessary before deciding the location.

An original well was drilled from this platform by an Ideal 50 rig and was abandoned as a dry hole at 6,706 feet.

A second well is now being drilled by an Ideal 100 rig mounted on this same platform, which has a capacity for drilling to about 12,000 feet. This well is located about 45 miles off-shore from Doha between Qatar and the Trucial Coast and the depth of water at this spot is about 42 feet.

The drill pipe passes through an outer pipe of sufficiently large diameter which is sunk several feet into the sea bottom and which stands several feet above the sea surface. This pipe is kept in position by being braced to the vertical rectangular legs of the structure.

The structure as standing at present was built for drilling at the present depth, but could be extended to enable drilling to take place in up to 100 feet depth of water. Modifications are in hand to make a standard structure from which drilling at any depth up to 100 feet can be carried out.

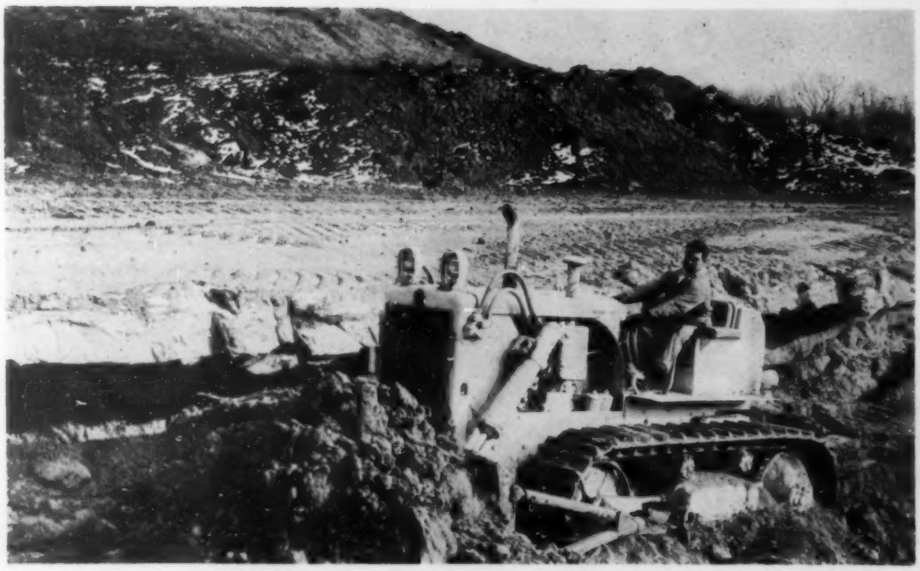
Once the structure and rig are in position, with the pipe through which drilling is done, sunk into position, drilling operations are normal.

The writer had the opportunity to visit this drilling island on March 8, 1956. At the time of his visit, drilling had reached a depth of 2,500 feet and was temporarily suspended. A Schlumberger test was being run and preparations were being made of setting 13⅜-inch casing.

Servicing of the rig, both in personnel and in food and light commodities is carried out by two helicopters, which were flown out to Doha under their own power. Under normal circumstances the journey between rig and shore takes about 40 minutes, dependent of direction and strength of wind. This can, however, vary considerably in the Persian Gulf giving rise to high seas in which it would be very difficult to land passengers from a launch on to the drilling rig.

The use of helicopters allows regular changes of shift for the drilling crews and also regular supplies of stores.

At the time of the above visit two records in travel between shore and rig were made. Owing to a strong head wind the journey out took an hour and a quarter, this being the longest time yet taken for the trip and conversely the return journey for the same reason only took 30 minutes, the shortest time taken. END



New 103 drawbar horsepower International TD-18 crawler tractor which features hydraulic power steering and positive self-energizing brakes.

IHC Stages Power Show

A showing of International Harvester Co.'s complete line of construction equipment was staged recenty at the company's Dundee, Ill., proving ground for a select group of construction magazine editors from all over the country. The demonstration climaxed a two-day press party designed to illustrate International's growth in the past five years. Five years ago International built only crawler tractors, power units, and engines for use in other makes of equipment.

Introduction of International's new Payloader and its new 18 and 24-ton Payhaulers, off-highway, rear-dump trucks, gives International a broader line of construction equipment than any other manufacturer in the industry, according to Harald T. Reishus, construction equipment division vice president.

International now produces seven models of crawler tractors, 18 power units, three sizes of 4-wheel scrapers, two self-propelled scrapers, two new off-highway trucks, a self-propelled, bottom-dump wagon, five International Drott Skid Shovels, and the new rear-engine Payloader.

In addition, the Frank G. Hough Co., a wholly-owned subsidiary, produces six rubber-tired, rear-engine, front-end loaders.

International also manufactures 228 different attachments to be used with its equipment, including upwards of 42 new Bulldozers, and Bullgraders.

New International cab-over-engine truck model powered by a heavy-duty truck type V-8 engine. The new International V-line consists of conventional and cab-over-engine, four-wheel and six-wheel models ranging upward from 24,000 to 50,000 pounds GCW. Engines range in horsepower from 206 to 257.

Geddes Appointed To National Supply Post

Alvin B. Geddes has been appointed assistant to the division manager for the Canadian division of The National Supply Co., with headquarters at Calgary. He will assist in the sale of all rotary drilling equipment. George R. Manson has been appointed division sales manager, succeeding Mr. Geddes.

Electric Drilling Power Drives

Stewart & Stevenson Services, Inc., Houston, Texas, has recently announced a new line of engineered gas and diesel DC drilling rig power drives. The new lines are called Rigelectric and are available with either the General Motors Detroit diesel engine as the prime mover or the Climax natural gas engine.

The standard basic power packages consist primarily of two models. The Model S12500 unit consists of either two Model 6-110 General Motors Detroit diesel engines rated 250 hp each, or two Climax Model K-75 natural gas engines arranged in a manner so that one power unit is directly connected to each end of a heavy duty traction type DC generator with a capacity of 600 hp continuous. The engines are connected to the generator shaft extensions through a heavy duty disconnect clutch and flexible connection on each engine. Special attention has been given to the arrangement of the flexible connection to permit satisfactory operation under extreme oil field conditions where considerable misalignment might occur. The entire unit is self-contained, mounted on a rigid structural steel skid type base.

The Model S241000 Rigelectric DC unit consists basically of either four Model 6-110 General Motors Detroit diesel engines rated 250 hp each, or four Model K-75 Climax natural gas engines with the four engines unitized and arranged on a common steel skid type base and powering two heavy duty traction type DC generators with a capacity of 600 continuous hp each.

All four engines and the two generators are compounded in such a manner as to permit the power of from one to four engines to be input to either one or both of the two generators. The engines are connected to generator shaft extensions through heavy duty disconnected clutches, and flexible connections similar to the above described S12500 Model unit; essentially the S241000 unit consists of two of the S12500 arrangements mounted on a common steel sub base with a compound drive tying the units together.

Particular attention has been given to simplification of the entire control system. Each motor is operated from an individual generator so that there is never more than one motor being driven from a single generator. This arrangement permits the use of a simple rheostatic, low voltage control to a pilot exciter for each generator which controls the speed of the electric motor without the necessity of a multitude of complicated controls.

The unique control system combined with the use of a separate generator for each electric motor, is so simple that usual drilling rig personnel without specific electrical training can easily understand it and trouble shooting can be accomplished without the need of highly trained electrical personnel.

All generators used on Rigelectric units are interchangeable. All of the heavy duty traction type electric motors are the same size so that in an emergency a replacement or switching of one motor to some other drive can be accomplished with the utmost simplicity.

The Stewart & Stevenson Multiple Engine arrangement is such that one power unit can be out of service for some reason; the other three combine to give three-fourths of the full power into the generators.

Maintenance is said to be much lower than on a mechanical driven rig due to the constant speed operation of the engines. Estimated normal life between overhauls is approximately doubled what is usually expected with the same engine on straight mechanical drive. Fuel consumption is lower because the engines are operating at their most efficient speeds constantly.

Opens Huge Valve Plant

A new 12-acre multi-million-dollar air conditioned plant of W-K-M Manufacturing Co., occupying a 75-acre site at Missouri City, west of Houston, was opened May 17. The new plant combines manufacturing operations of W-K-M Manufacturing Co., Inc., Houston, makers of gate valves; The Key Co., East St. Louis, manufacturer of return bends and welding fittings; and the ACF valve division, Detroit, producer of lubricated plug valves.

Although the three are under one roof, the plant is so designed that each product group has its own individual production lines.

Machinery from the former W-K-M plant in Houston, from the Key plant and from the Detroit plant has been set up along with the new equipment essential to the expanded operation under the consolidated operation.

The equipment that covers the 12 acres of floor space includes some 700 individual machine tools. Automatic cutting and turning are incorporated in many of the machine tool designs for milling, boring, turning and finishing plug valves as small as one-half inch and gate valves as large as 34 inches, along with a family of fittings as intricate as the piping requirements of the processing industries.

With the exception of second-floor office space of 1,200 square feet, the plant's 12 acres of floor space is at ground level. Since offices, engineering space, reception and conference space require only 48,000 square feet, the manufacturing plant alone covers close to 11 acres at one floor level. The plant has a 2,250-ton air conditioning system for summer cooling which converts to wintertime heating by the circulation of heated water through the piping system. The windowless building is of steel frame construction.

The W-K-M pipe line valve machining line at its new Houston manufacturing plant.

An Outline of the Application To Oil and Gas Corporations of—

CANADIAN INCOME TAXES

By D. A. McGregor

THE income of corporations operating oil and natural gas wells in Canada is determined in the same manner as other businesses except that special deductions are allowed in respect of:

(1) Drilling and exploration expenses, including all geological and geophysical expenses.

(2) Depletion.

Reference to these special deductions has been included in The Income Tax Act and its regulations for some years but the Canadian oil and gas industry is still in its infancy and jurisprudence in this field of taxation is limited. However, despite the fact there are a number of matters to be clarified by the courts, the general principles of oil and gas taxation are fairly well defined.

The rates of taxation applicable to corporations are 20% on the first $20,000 of taxable income and 47% on any excess.

In practice the term "drilling and exploration expenses" is broadly interpreted in the case of those companies carrying on an active exploration and development program, to cover all expenditures in Canada, including general and administrative overhead, with the exception of:

(1) Lease rentals and similar property carrying charges in excess of $1 per acre per year.

(2) Bonus costs of lands with exception of the bonus costs of leases paid in 1953 or subsequent years to the Federal or a Provincial Government where no production has been obtained from the lease and it is surrendered without receiving any consideration for it.

(3) The cost of depreciable fixed assets.

(4) Expenditures which are not permitted as deductions from income by the general provisions of The Income Tax Act, such as certain expenses in connection with issuing shares or borrowing money and payments for goodwill.

Drilling costs include not only the actual costs of drilling but also the cost of building access roads, preparing the drilling sites, costs of casing, cementing and bringing the well into production, etc. The costs of tubing, pumps, flow lines, tanks and other equipment above ground are considered to be capital assets subject to capital cost allowance.

It is interesting to note that the cost of casing is considered to be a drilling expenditure in Canada, whereas in the United States casing is considered to be a depreciable asset.

Corporations entitled to deduct drilling and exploration expenses are those whose "principal business is production, refining or marketing of petroleum, petroleum products or natural gas, or exploring or drilling for petroleum or natural gas, or mining or exploring for minerals." Canadian corporations who do not qualify as above are restricted to a deduction of the drilling costs of productive wells situated outside of Canada on a well by well basis and accordingly to all intents and purposes the deduction of drilling and exploration expenses is restricted to those companies which are actually engaged in the petroleum or mining industries.

Photo by Macbe

D. A. McGregor is a partner in the firm of Clarkson, Gordon & Company, an outstanding accounting firm in Canada. He is a graduate of the University of Saskatchewan in Business Accounting and a member of the Institute of Chartered Accountants of Alberta and Saskatchewan and of the Petroleum Accountants Society of Western Canada.

The amount of drilling and exploration expenses that a qualifying corporation is entitled to deduct from income is restricted to the lesser of the expenditures incurred or its income for the year and drilling and exploration expenses in excess of income may be carried forward indefinitely from year to year. This treatment differs from that accorded to such expenditures in the United States where drilling and development expenses are treated on exactly the same basis as any other expenses so that the excess of such expenses over income merely creates losses which may be carried back two years or forward for five years in the ordinary way.

Canadian companies are not required to capitalize any part of their drilling and exploration expenses incurred in connection with properties obtained as a result of exploration work as is required in the United States. In addition, the corporation which is considered to have "incurred" the exploration expenditures is entitled to the whole deduction and is not required, as a United States taxpayer would be, to capitalize a part of intangible costs if a well is drilled under a farmout agreement for a less than 100% working interest.

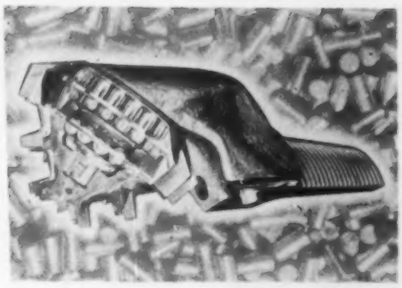
As indicated above, the deductibility of exploration expenditures is restricted to the corporation which incurred the expenditures and therefore a merger of several companies, each with an excess of exploration expenditures over income received would not result in that tax advantage being carried forward into the new entity. Similarly, new entities resulting from a spin-off or split-up will normally not be able to carry forward drilling and exploration expenses incurred by their predecessors. Because of this loss of tax benefits such corporate reorganizations have not been widely used in Canada to date in the oil industry.

For Canadian tax purposes depreciation of fixed assets must be calculated at specified rates on the reducing balance method as compared with the United States where a variety of methods may be adopted. However, the amount of depreciation written in the corporation's accounts need not agree with the amount of depreciation claimed for Canadian income tax purposes.

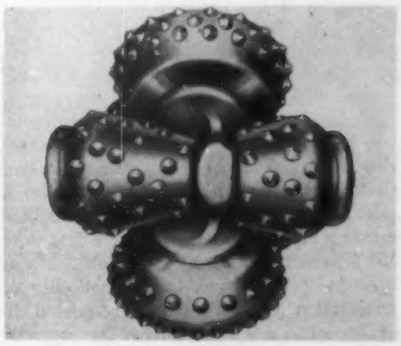
An important difference between the tax laws of Canada and the United States is the treatment accorded capital gains. There is no tax on capital gains in Canada—each profitable disposal of property results in either a capital gain on which no tax is payable or ordinary income subject to the usual rates of tax. However, as in the United States, whether a disposal of property results in a capital gain must be decided on the facts of each case and it has become increasingly difficult in Canada during the past few years to determine in advance if a proposed transaction will give rise to a capital gain or ordinary income.

Depletion is allowable under the Canadian Income Tax Act on a percentage of profits basis to two classes of taxpayers, namely, "operators" and "non-operators."

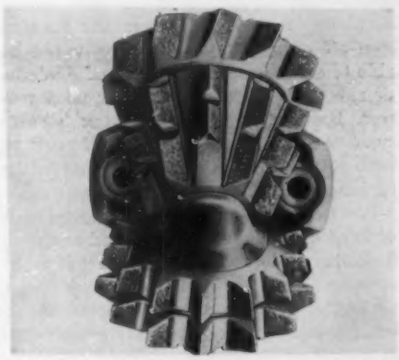
(Continued on page 86)



Cut-away view of rock bit bearings. Roller bearings support the radial load. Ball bearings which retain cones on the bearing pins function as a radial bearing and resist thrust loads acting longitudinally along the bearing pin. (Photo courtesy of Hughes Tool Co.)



"Cobra" rock bit for formations which drill most effectively by crushing. This type bit gives its best performance in chert. (Photo courtesy of Reed Roller Bit Co.)



Barracuda 2-cutter bit designed to replace drag bits in soft formations. Bit is equipped with slush nozzles. (Photo courtesy of Reed Roller Bit Co.)

Rock bit after assembly and welding, but before final finishing and threading. (Photo courtesy of Reed Roller Bit Co.)

Progress in Development of Rotary Drilling Bits

(Continued from page 49)

employs an electric arc operating in an atmosphere of hydrogen (the "atomic" hydrogen method) has been successfully applied by some manufacturers and is said to obtain a superior bond between the hard-facing metal and the underlying steel surfaces of the cutter element. Tungsten carbide reinforcement is expensive, but pays off in greatly increased footage obtained from bits so protected, and time saved in changing bits.

The main body of a roller-type bit consists of drop-forged segments that are fitted and welded together after the cutter elements have been attached. The pins that support the cutter elements may be forged integrally with the body segments and are accurately machined, ground and carburized before the bearings and rotating elements are assembled on them. Once assembled and the segments are welded together, the cutting elements cannot be removed unless some part fails in service. The shank of the tool is equipped with a threaded "pin" joint for connecting with the lower "box" of the drill collar.

Teeth may be formed on the cutting elements during the process of forging, but most manufacturers form the teeth by cutting out portions of the smooth-surfaced forgings with the oxyacetylene torch or by turning on the lathe, milling and grinding. The interior raceways for the bearings are formed on a lathe. Tungsten carbide or other hard-facing material is then applied to such parts of the cutters as are subjected to greatest wear. The cutters are then case-hardened, usually by gas carburizing. The depth of the carburizing effect is carefully controlled, seeking a compromise between that of the hard, brittle qualities of the cutter surfaces and the thickness of normal metal below the hard-facing, upon which dependence must be placed for qualities of toughness and resistance to fatigue and shock-loading. After case-hardening, the cutters are tempered and quenched, and are then ready to assemble on their supporting pins.

In assembling, the carefully heat-treated roller bearings are placed in their raceways, set in heavy grease. The ball bearings, which serve to lock the cutters on their supporting pins are last installed, heavy grease injected, and sealed in their enclosed raceways. The several segments of the bit, with all cutters mounted in position, are then assembled and welded together, and finally the threaded pin joint, by means of which the bit is attached to the drill collar, is formed by turning on a lathe.

The hydraulic elements of the bit must be carefully designed to deliver the drilling fluid on bottom with minimum pressure loss, yet with sufficient turbulence to keep the cutting elements free of clay and lift the cuttings rapidly toward the surface. Tricone bits of conventional type are designed to discharge the drilling fluid directly downward against the top edges of the cones, near the axis of the tool. Two-cone bits have two similarly placed discharge ports. The more recently developed jet bits discharge the fluid between the cones, near the periphery of the tool, so that the fluid jets impinge directly against the bottom of the hole in the path of the cutting elements. Dependence is placed upon the turbulence created by the abrupt change in direction of flow to keep the cutting elements free of clay and cuttings. The fluid distribution about the bit is an important factor in determining its rate of progress and service performance. A reinforcing nozzle is placed on each discharge port to provide a moderate constriction in each flow channel, thus increasing the jet velocity and its erosional effect. Jet bits are usually designed to provide a jet velocity of from 175 to 225 feet per second, depending upon pump capacity.

Earlier models of cone bits were equipped with two cones, mounted 180° apart on supporting pins, and the cones were so positioned that their cutting edges were pressed in a nearly horizontal line against the bottom of the hole. The more recently developed tricone bit, as the name suggests, provides three cones, each mounted on its own supporting pin, 120° apart. Though the cones in a tricone bit are somewhat smaller than in the two-cone models, they provide more and a greater linear feet of cutting teeth. The three-cone models permit interlocking of the teeth on the cones as they rotate, a self-cleaning feature that facilitates removal of clay and cuttings that may tend to "ball-up" in the cones when operating in soft formations. Two-cone bits are still preferred by some drillers, particularly for drilling in steeply inclined, laminated, hard formations where deflection of the hole from vertical is likely to occur. A greater load may be applied on a two-cone bit than on a three-cone bit under such circumstances without causing the bit to deviate from its vertical course. Two-cone bits also provide more clearance between the body of the tool and the wall of the well, and there is more clearance between and about the cones, so that they are less likely to become stuck in the hole when drilling in soft formations.

Some early models of roller bits were equipped with lubrication devices, but development of antifriction roller and ball bearings has removed the necessity for this. Drilling fluid has access to the bearings, and while this fluid is of questionable lubricating value, its plastic qualities reduce friction in some degree. The bearings are well enclosed, with small clearances between the cutters and their supporting elements, and are thus shielded from direct contact with the drill cuttings. Only very fine gritty material suspended in the drilling fluid may find its way into the bearings, and this of course, is abrasive and destructive. The bearings are customarily well lubricated with grease as they leave the

(Continued on page 74)

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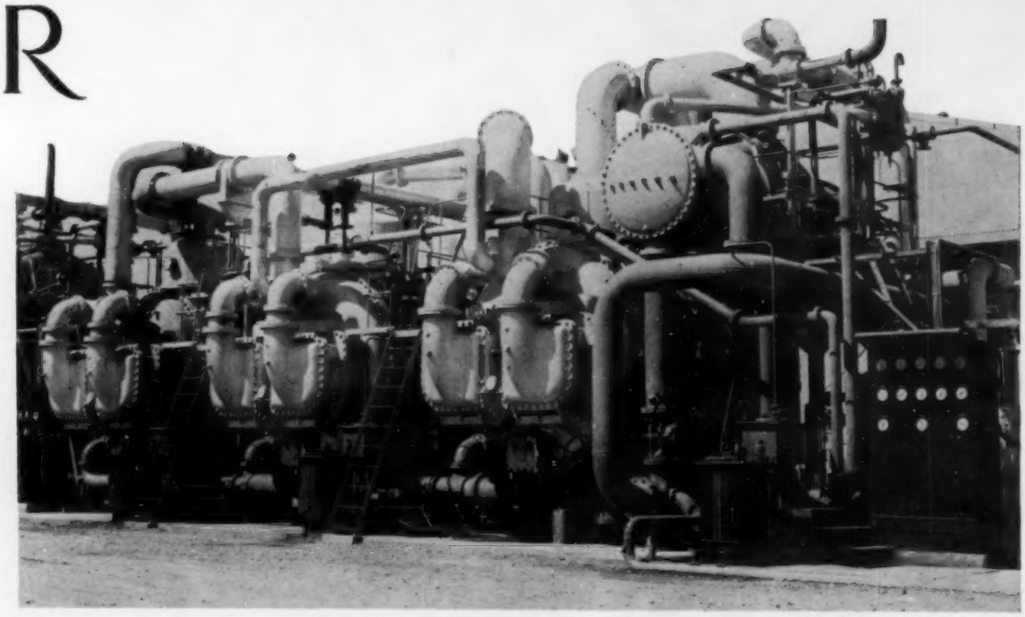

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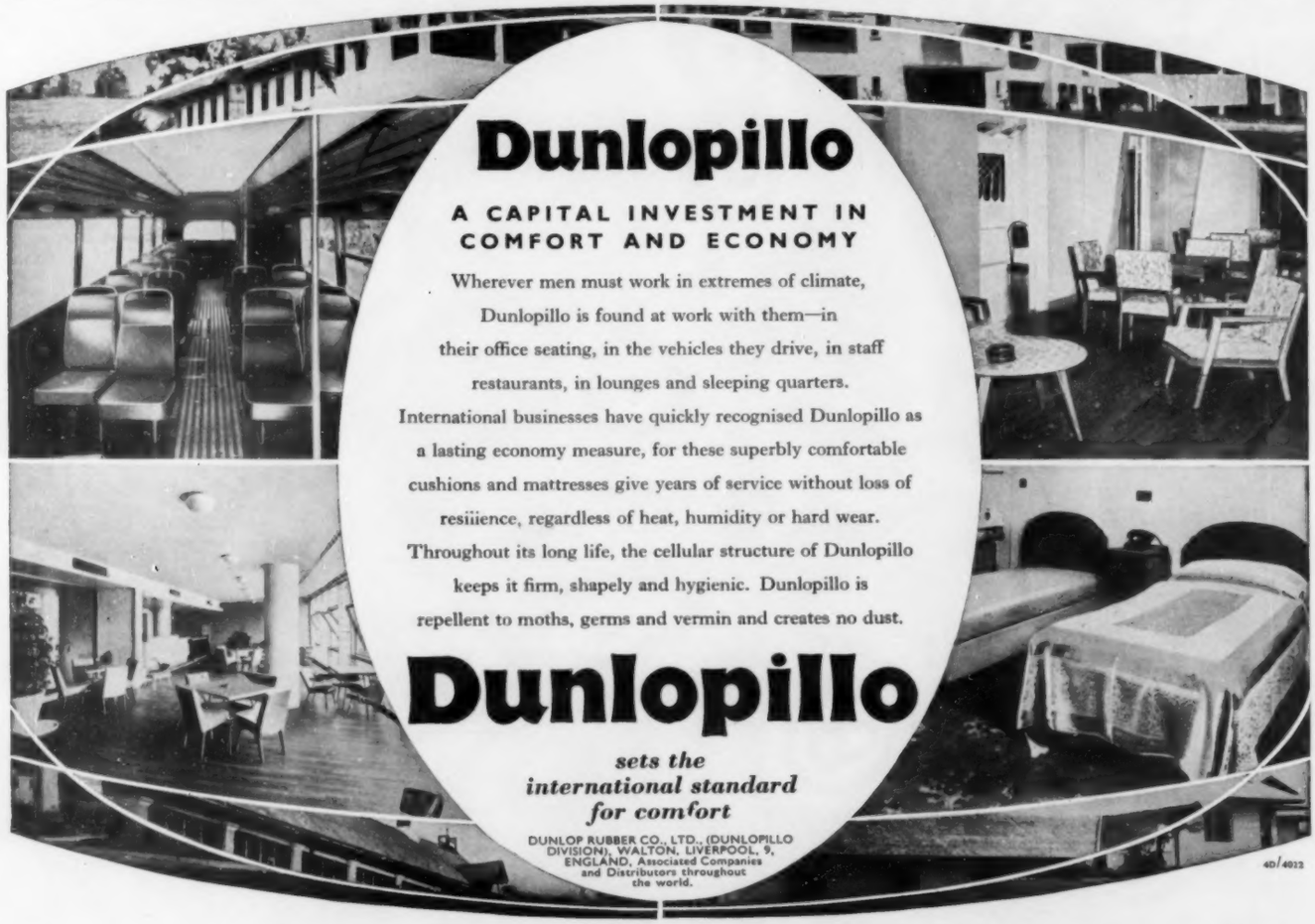
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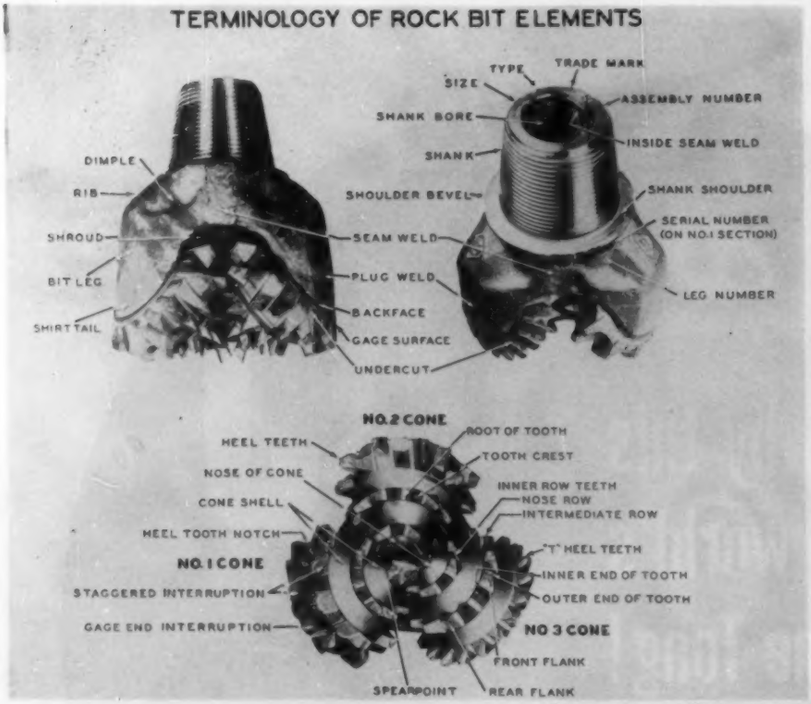

Photo courtesy of Hughes Tool Co.

Progress in Development of Rotary Drilling Bits

(*Continued from page 70*)

factory, which protects against corrosion of the machined raceways, rollers and balls during transportation and storage, but the grease is quickly squeezed out when bit pressure is applied in drilling.

In concluding this section on mechanical design of drilling bits, we may conveniently summarize the requirements that a satisfactory rotary bit must fulfill:

1. With a suitable rate of rotation and weight imposed by the drill column, the bit must be capable of disintegrating the rock in its path, forming chips or cuttings of a size that can be circulated to the surface by the drilling fluid.

2. The "eyes" of the bit through which drilling fluid is discharged, must be so placed and must be of such size that the fluid emerges under high velocity, and by its turbulent, swirling motion, keeps the cutting elements of the bit free of sticky clay and lifts the cuttings promptly off bottom.

3. The form of the bit and the position of the cutting elements must be such that it drills a straight, smooth-walled hole, while suitable clearance is maintained between the bit and the wall of the well.

4. The material of which the main body of the tool is made must be tough, elastic and resistant to fatigue and shock-load damage, while its cutting elements must be hard and resistant to abrasion.

5. If the bit is of a type that employs rolling cutting elements, they must be supported by bearings of a size and type that will provide security against crushing by excessive weight that may be imposed by the drill column and that will reduce friction to a minimum.

6. Because of the necessity for replacement of drilling bits as a result of wear in service, they must be attached to the drill column by threaded connections that will permit of readily disengaging them from the supporting collar; and these threaded connections must be so designed that they will be protected against abrasive wear, and so that they will withstand the severe impact loads to which the drill column is subjected in drilling service.

Research on Improvements in Drilling Equipment and Methods.—Some of the drilling bit manufacturers have spent and are currently spending large sums in searching for improvements in drilling bit design, materials and quality control. The Hughes Tool Co., for example, at its Houston plant, has provided a modern laboratory building with some 60,000 square feet of floor space, equipped with all facilities useful in chemical and metallurgical analysis, mechanical testing of materials, heat treatment and welding of metals. It also includes machine shops equipped for construction of new types of drilling bits and special facilities are provided for testing equipment in pilot-drilling operations under controlled conditions.

The American Association of Oilwell Drilling Contractors, assisted by funds subscribed by various oil companies, has also been supporting a research program at the Battelle Memorial Institute, in Columbus, Ohio. This program has had broad objectives and has been exploring the basic problems of the well-drilling industry, looking toward improvement in methods of drilling and equipment. A recent progress report emphasizes the importance of maintaining a balanced, low-viscosity drilling fluid that promptly removes drill cuttings from the bottom of the hole, and suggests a modified type of jet bit that directs its fluid jets at the line of contact of the cutting edges of the bit with the formation.

This research group also confirms claims made some months ago by Russian technologists, that certain chemical additives in the drilling fluid (such as sodium hydroxide, sodium carbonate and sodium silicate) will soften rock formations so that drilling bits may make faster progress and achieve greater footage. The qualities of the drilling fluid were studied primarily from the standpoint of bit performance and removal of drill cuttings, but it must be remembered that the drilling fluid has other important functions to perform which may require properties not reconcilable with those considered important in efficient bit operation. The effects of the suggested chemical rock softeners on the properties of the drilling fluid and its ability to perform its several functions, must also be considered. It seems doubtful that chemical reagents in the drilling fluid could gain access to material in the path of the bit rapidly enough to be effective in materially altering the rock properties.

Oil company research groups have also been active in searching for new and improved drilling methods. A Carter Oil Company research group has been experimenting with an entirely new technique of drilling in which steel pellets are driven by hydraulic force against the formation to be penetrated. Impact action of the steel pellets disintegrates the formation, while the circulating fluid sweeps the pulverized material to the surface. Success of such a method would, of course, profoundly alter our present techniques of drilling.

The turbo drill has been used only to a limited extent in this country, though it has been widely used in the Russian oil industry. This method of drilling employs an hydraulically actuated turbine, placed just above the bit in the drill column, to rotate the bit. The drill pipe supports the turbine and bit, but does not revolve. Conventional rotary bits may be used, though studies may show that changes in bit design and methods of bit-pressure control will be advantageous. Advantages claimed for the turbo drill include conservation of power, less wear and stress on drill pipe, increased drilling speed and lower drilling cost, but some of these claims are questionable. The principal difficulty in use of this method is said to be the rapid abrasive wear by the gritty drilling fluid on the gears and rotating elements of the hydraulic turbine.

Some authorities suggest that best results in drilling hard, brittle formations can be achieved by combining a rotary scraping and chipping action with a percussion or impact action of the thrilling bit on the formation. A tool designed to accomplish this has lately been successfully demonstrated in drilling chert and other hard formations that are difficult to penetrate with

(*Continued on page 76*)

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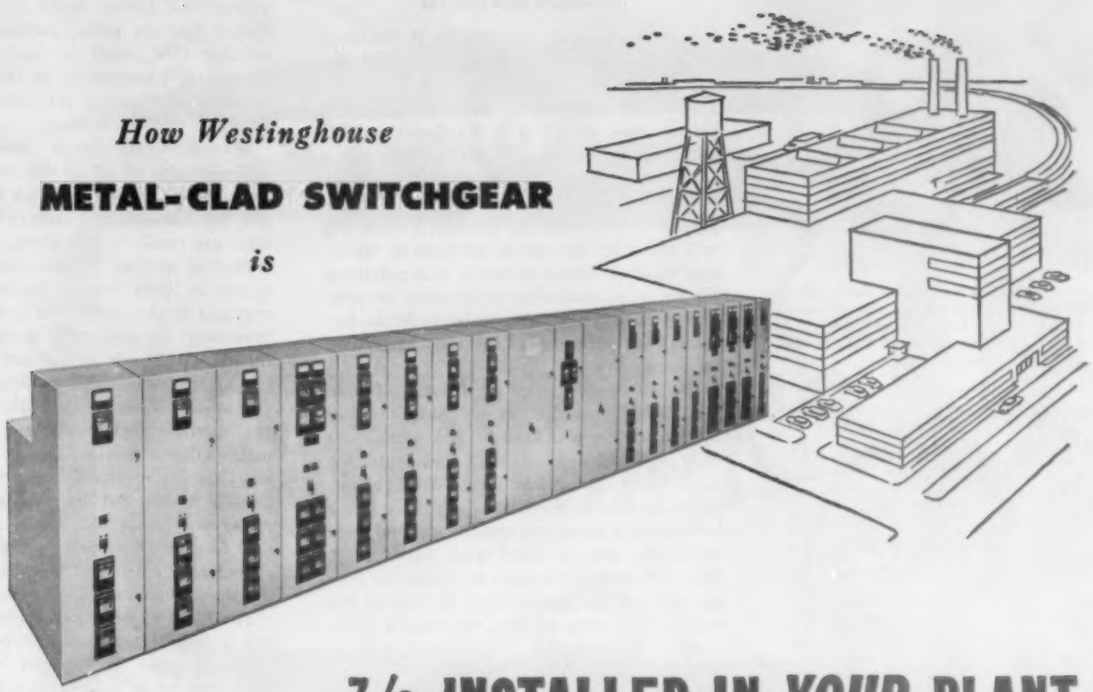

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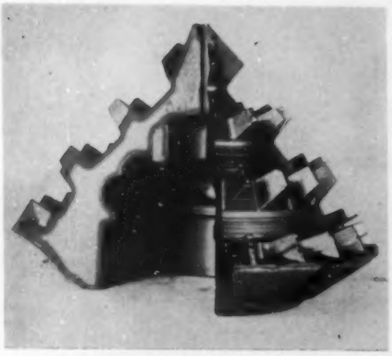
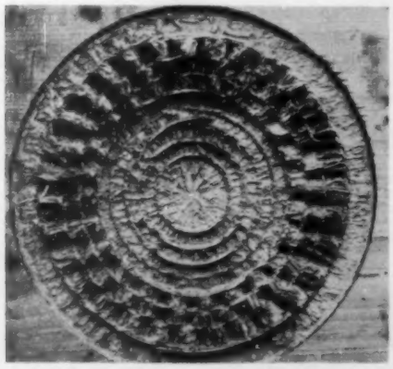
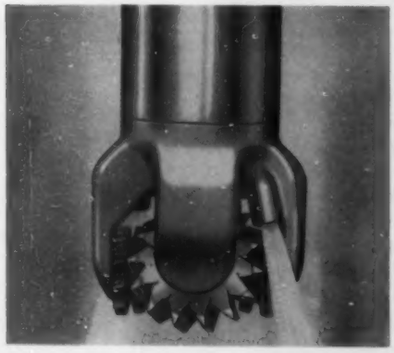


Sectioned rock bit cutter which has been sand-blasted to show hard, wear-resistant case on teeth and bearing races and softer, shock-resistant core in teeth and shell. (Photo courtesy of H. C. Smith Oil Tool Co.)



Bottom-hole pattern formed by hard formation type tricone bit. (Photo courtesy of H. C. Smith Oil Tool Co.)



Illustrating fluid circulation through jet cross-section bit. (Photo courtesy of Security Eng. Div., Dresser Industries.)

Jet type tricone and two cone bits. (Photo courtesy of Globe Oil Tools Co.)

Progress in Development of Rotary Drilling Bits

(Continued from page 74)

conventional rotary equipment. A modified type of cone bit has been developed for this kind of drilling.

Oil-base and emulsion drilling fluids permit rotation of the drill column and bit with less frictional power loss than when water-base muds are used as the circulating medium. Penetration rates and drilling-bit footage can be increased from 1½ to 3 times by the use of oil-base or emulsion muds. It seems probable that a drilling bit behaves somewhat differently in contact with oil-base or emulsion fluids because of differences in the interfacial forces involved.

Drilling with gas or air instead of mud fluid as the circulating medium, imposes marked changes in bottom-hole conditions that probably have an important influence on drilling bit performance. When air or gas is used as the circulating medium, lower bottom-hole pressures are maintained than when the well is filled with liquid mud. The differential pressure between the formation and the space about the bit in the well is increased, so that the rock is more readily disintegrated. The drilling rate is increased and drilling bit footage is increased.

Research may profitably be directed toward basic studies of the physical properties of rocks and the way they respond to disintegrating forces. A rock which has a high compressive strength, which resists penetration by the cutting elements of a drilling bit, or which has abrasive properties which occasion rapid wear on the cutting elements, will often respond to a crushing or chipping action. On the other hand, a rock with a weak binder, such as clay-shale, behaves more like a plastic material. Under the high formation pressures such rocks may appear to flow.

Economic aspects of drilling bit performance.—A drilling bit is capable of achieving only a certain footage in routine drilling operations, as a result of which it becomes so worn that it must be replaced by another. The footage obtained from a bit varies widely, depending upon the character of the formation in which it is operating, the design of the bit, the quality of the materials of which it is made, and the skill of the driller in maintaining appropriate bit pressure, rotational speed and drilling fluid supply. Selection of a style of bit appropriate for the formation in which it is to be used is particularly important. Actual footages obtained in practice with bits of roller type, range from but a few feet under very adverse circumstances, to many hundreds of feet under favorable conditions, averaging perhaps 150 feet.

Because of the difficulty of providing adequate bearings and thicknesses of metal to resist abrasion, small diameter bits usually yield smaller footages and have lower penetration rates than medium and larger diameter bits. Best performance under normal conditions is apparently secured with bits ranging from 8⅝ to 9⅞ inches in soft formations, and from 6¾ to 9 inches in hard formations. Lower tooth heights and reduced bearing areas necessarily used in smaller bits result in less efficient performance, particularly in deep, hard formations where high bit pressure must be used.

Manufacturers must maintain warehouse stocks of all of the commonly used sizes and types of bits in all regions where drilling is active, and their field representatives are ready to give prompt delivery and technical advice in the selection of bit types. In their manufacturing plants and regional stores, they must maintain a large inventory to promptly meet service demands. Bits are customarily rented or leased to the drilling contractors and oil companies. They remain the property of the manufacturer, and after they have yielded their useful footage in drilling service, they are returned to the manufacturer, usually to be cut up and sold as scrap metal or melted for use in production of new forgings. The cost per bit to the purchaser ranges from $100 to $1,400, depending upon the size and type of bit.

The bit cost per foot of hole drilled varies widely, depending upon conditions, but in some areas has ranged from $0.07 to more than $1.00. In drilling a deep exploratory well, more than a hundred bits may be used. The average number per well for wells drilled to depths in excess of 15,000 feet during 1955 has been estimated at 85. If their average cost is say, $175, the bit cost per well would average $15,000, or as much as $1.00 per foot of hole drilled. If it is assumed that the average bit cost is 50 cents per foot of hole drilled—believed to be a conservative figure—in a year in which 200 million feet of rotary drilling is done (1955), the total cost of rotary bits used in the U.S. drilling industry would be one hundred million dollars. END

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To Conduct *In Situ* Research

The College of Mineral Industries of the Pennsylvania State University will conduct further research this year into *in situ* combustion as a means of increasing oil recovery. The Pennsylvania Grade Crude Oil Assoc. is raising funds to aid in the study.

Production Research Project by Gulf

Gulf Research & Development Co. has undertaken a production research program to improve recovery of petroleum from oil fields. Specific aims include increasing the percentage of petroleum recovered from oil formations, and bettering both the speed and the economy of drilling wells, producing and transporting oil and gas.

Two new buildings, to cost approximately $1.5 million, will house these activities, for which additional staff members are now being recruited. Both will be begun this spring. The smaller, for heavy drilling research, is scheduled for completion in August and the main building in January, 1957.

New French 33,000-Ton Tanker

Societe Francaise des Petroles BP, has placed an order for a fourth 33,000 dwt tanker, the "Chaumont," due to be completed by 1958. It will be built by Ateliers et Chantiers de France, Dunkirk.

Esso Development Name Changed

Esso Development Co. Ltd. has changed its name to Esso Research Limited. The step was taken to "reflect more accurately the company's varied and expanding activities in the field of petroleum research."

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Appointed Engineering Director

J. S. Downs, president of W-K-M Manufacturing Co., Inc., has announced the appointment of H. Ben Young as director of engineering. He formerly was with Mission Manufacturing Co., where he served for many years as chief engineer and, for the past several years, as director of overseas projects.

Appointed to Cleveland Sales Office

N. Carey Iler, Jr., has been transferred to the Cleveland sales office of Chicago Bridge & Iron Co. and Oliver E. Norris has been assigned to the company's New York sales office.

Mr. Iler joined the Pacific Coast erection division of the company in 1953 and is a graduate of Cornell University. Mr. Norris joined the Chicago engineering department of Chicago Bridge & Iron Co. in 1952 and is a graduate of the Colorado A & M College.

Ethyl Expansion Considered

Ethyl Corp. has taken options on land near Joliet, Ill., as a possible site for a new "Ethyl" antiknock compound manufacturing plant. Ethyl Corp. owns plants in Baton Rouge, La., and Houston, Texas, and its subsidiary, Ethyl Corp. of Canada, Ltd., is presently building a plant near Sarnia, Ontario.

New MagCoBar Vice President

Floyd A. Enz has been named vice president and secretary-treasurer of Magnet Cove Barium Corp. James B. Graves has been appointed controller of Magcobar to succeed Mr. Enz.

Floyd A. Enz

S = $

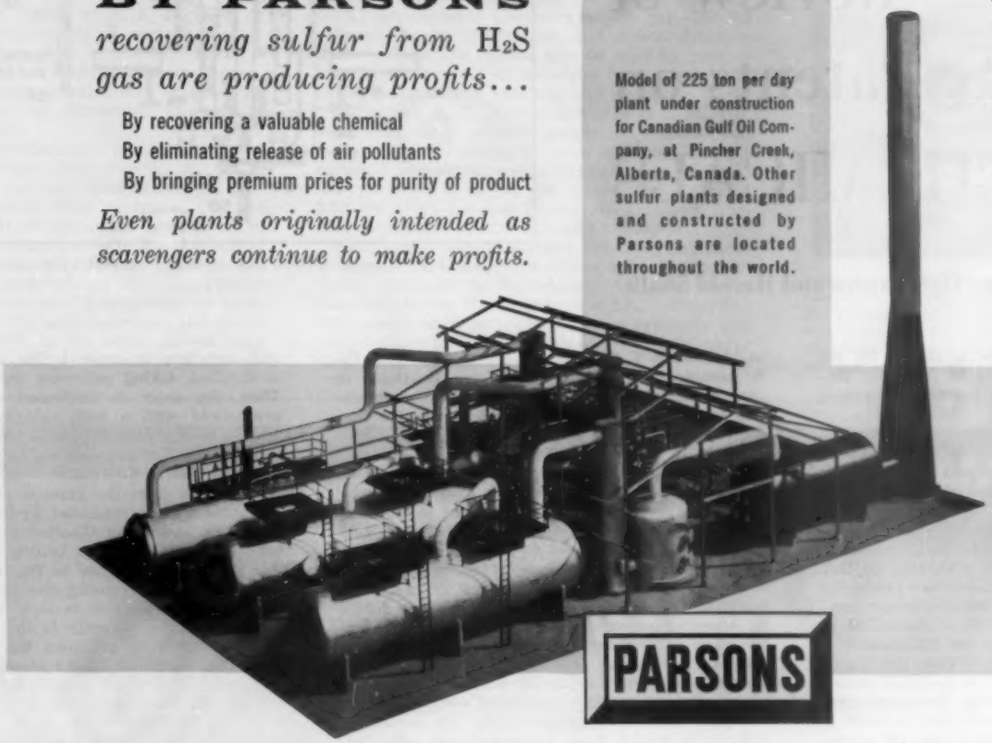
30 PLANTS BY PARSONS

recovering sulfur from H_2S gas are producing profits...

By recovering a valuable chemical
By eliminating release of air pollutants
By bringing premium prices for purity of product

Even plants originally intended as scavengers continue to make profits.

Model of 225 ton per day plant under construction for Canadian Gulf Oil Company, at Pincher Creek, Alberta, Canada. Other sulfur plants designed and constructed by Parsons are located throughout the world.



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The current review deals with the production, purification and reactions of acetylene. Because of its great importance as a chemical raw material, acetylene has been the subject of a large number of patents. In this review 24 patents are considered most of which are devoted to acetylene manufacture and purification. Acrylonitrile and other vinyl monomers, which are some of the most important chemicals made from acetylene, are the subject of some seven of the patents reviewed here.

Review of U.S. Patents on PETROCHEMICALS

By Heinz Heinemann and Harold Shalit

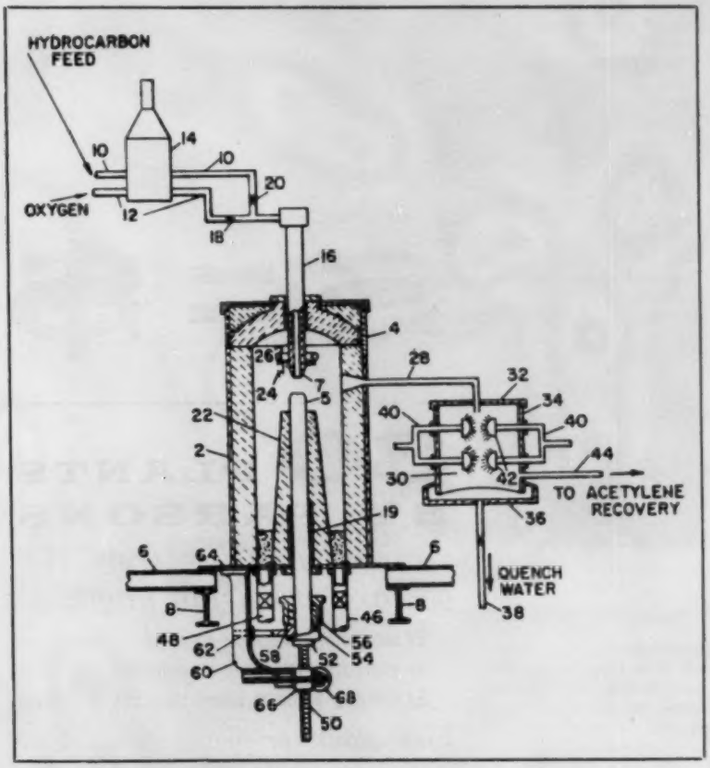


Fig. 1. R. Mungen, Method and Apparatus for making Acetylene, 2,721,227.

The importance of acetylene is shown by the large amount of patent activity in this field. Reviewed in this article are 24 patents concerning acetylene:

1. Production of Acetylene. The two main reactions for producing acetylene from other hydrocarbons are incomplete oxidation and high temperature thermal cracking. J. L. Bills of Union Oil Co. in 2,713,601 proposes a processing scheme for the partial oxidation of non-aromatic hydrocarbons comprising the following steps: (1) the hydrocarbon and oxygen containing gas are preheated so that no reaction takes place, (2) the acetylene producing reaction is initiated by introducing a hydrogen containing gas, (3) the temperature is controlled at 1100°-1500°C, (4) contact times are maintained at 0.001-0.05 seconds, (5) the product gases are cooled by heat exchange with water to produce steam, (6) hydrogen is made by passing the steam over metals or metal oxides, (7) hydrogen so made is recycled to the acetylene producing step, (8) acetylene is separated from the product gases, and (9) the metal oxides are reduced by the acetylene free product gas. An apparatus for carrying out this process scheme is patented in 2,726,276 by W. S. Dorsey also of Union Oil Company. The process is made self-sufficient in heat by dividing the reactant gas into two streams and passing them into opposite ends of a reactor constructed so that the preheat zone for one stream lies adjacent to the quench zone of the other, and in indirect heat exchange with it. Hydrogen is introduced into the reaction zone containing the preheated reactants.

Two patents assigned to Badische Anilin-und Soda-Fabrik, A.G. propose apparatuses for carrying out the partial combustion of hydrocarbons. In 2,715,648, H. Sachsse, T. Kosbahn, E. Lehrer suggest passing the hydrocarbons mixed with oxygen through channels in ceramic blocks so constructed that they impart a spiral movement to the gases passing through them. It is claimed that this improvement allows the channels to be made larger than heretofore possible. In 2,719,184, T. Kosbahn and E. Lehrer design an apparatus to reduce coke formation during the partial combustion. Their apparatus comprises a gas distributor made of a heat conducting substance and containing a circulating coolant. The reaction chamber may also be made of the conductive material with coolant.

A modified type of thermal cracking is claimed in 2,718,534 by F. W. Harris of the Wulff Process Co. A suitable hydrocarbon charge gas (methane or gaseous olefin) is passed through a first "regenerative mass," the inner end of which is hotter than the outer, to bring the reactants up to reaction temperature. The charge gases are then mixed with hot combustion products, to provide the reaction heat, after which the products pass through a second "regenerative mass" to recover heat. Periodically the flow of gases is reversed. R. Mungen (2,721,227 to Stanolind Oil and Gas Company) has designed an apparatus in which gaseous or liquid hydrocarbons are cracked on the surface of preheated, massive carbon. The surface is preheated to 2000°F by allowing an oxygen-hydrocarbon flame to impinge on it. The oxygen is shut off and cracking goes on until the temperature is 1600°F. The cracked, acetylene containing products are cooled rapidly by traversing a curtain of steam. (Fig. 1.)

Higher acetylenic hydrocarbons are sometimes difficult to obtain. Such compounds are made according to J. Happel and C. J. Marsel (2,719,872) by subjecting a compound with at least one aliphatic tertiary hydroxyl group to thermal cracking in the presence of at least 50 mole % steam at 800°-900°C, with contact times less than five seconds. For example, methylacetylene is made from t-butyl alcohol.

2. Separation, Purification, and Handling. For most of its uses acetylene must be quite pure, so that techniques for separating it from accompanying gases are important. In addition, the explosive properties of the compound require that special techniques be developed for handling it. These matters are the subjects of five patents.

J. D. Christian of Monsanto Chemical Company (2,715,100) patents acetylene solvents such as tetrahydrofuran and its mono- and di-alkyl substituted homologues in which the alkyl groups have 1-4 carbon atoms. These solvents may be used for storing acetylene or for extracting it from gas mixtures. In the production of acetylene, it is necessary to remove explosive acetylene polymers; this is accomplished by W. E. Alexander also of Monsanto Chemical Company in 2,715,947. The impure acetylene is compressed and scrubbed with an oxygenated solvent for acetylene and its polymers, which solvent boils higher than water and contains not more than 15% water. (e.g. dimethylformamide, 8-butyrolactone, etc.). The pressure is reduced on the solution and acetylene is evolved. The remaining solution is distilled, taking polymers and water overhead. Then, the water is condensed, and the polymers are mixed with a high velocity jet of combustible gas for disposal. In a patent by E. Bartholomé, E. Lehrer, and L. Lorenz (2,719,601 to Badische Anilin und Soda-Fabrik, A.G.) acetylene is recovered from the gaseous product of thermal decomposition of saturated hydrocarbons by contacting the gas in an absorber at 2-10 atmospheres with an organic solvent boiling above 100°C. The rich solution is pumped to the top of a rectifying column while decreasing the pressure to atmospheric, and is allowed to flow down the column. Flowing countercurrently to the solvent stream is a gas obtained by stripping the solvent emerging from the column at 0.2-0.5 atmospheres and at an elevated temperature below the boiling point of the solvent. Pure acetylene is withdrawn at some mid-point in the column. G. A. Akin in 2,731,507, assigned to Eastman Kodak Co., patents a method for recovery of acetylene which removes the necessity of flashing acetylene from rich extraction solutions. The impure acetylene (containing ethylene) is contacted with a preferential acetylene solvent such as dimethylformamide or dimethylacetamide. This extract is then contacted with a hydrocarbon oil, such as dodecane, to remove any dissolved ethylene.

The transport of highly explosive acetylene through pipes at super-atomospheric pressure is a dangerous procedure and can be accomplished only by using special methods, L. C. Kemp, Jr. of the Texas Co. in 2,730,438 minimizes the danger in such transport by suspending in the compressed gas particles of heat conductive material inert to acetylene. The size range of the particles should be in the range 10-80 microns. The mixture is pumped at a velocity sufficient to maintain the solid particles in suspension.

3. Preparation of vinyl monomers from acetylene. In this section are considered those patents dealing with the preparation of acrylonitrile, acrylates and acrylic acid, and vinyl halides from acetylene. In the preparation of acrylonitrile by reacting acetylene and HCN over copper chloride solution, some tar is formed which gradually deactivates the catalyst. C. J. Stehman, in 2,649,418 to Monsanto Chemical Co., proposes to remove the tar from catalyst solutions by extracting the solution with

a liquid organic compound containing a nitro, nitrile, phenolic, or keto group, and which boils above 80°C. in 2,649,472, G. H. Lovett of Monsanto Chemical Co. details a process for obtaining acrylonitrile from acetylene and HCN over cuprous salt solutions, which acrylonitrile is free of contaminants such as chlorobutadiene, mono- and divinylacetylene. The product gas from the acetylene-HCN reaction is partially condensed to form an organic phase and a water phase. Additional water is added to the organic phase to dissolve out the acrylonitrile together with some of the contaminants mentioned above. The combined water layers are then contacted with the uncondensed gas, whereby the contaminants pass into the gas phase and an uncontaminated acrylonitrile-water solution is obtained. Another scheme is given by G. C. deCroes and G. A. Akin (2,733,259 to Eastman Kodak Co.) for isolating acrylonitrile from other reaction products of acetylene and HCN. In this scheme the gaseous products are cooled to 20-30°C and the uncondensed gases are then washed with water to absorb acrylonitrile. The aqueous solution is stripped with acetylene to remove cyanobutadiene. Pure acrylonitrile is recovered from this water solution by a series of distillations.

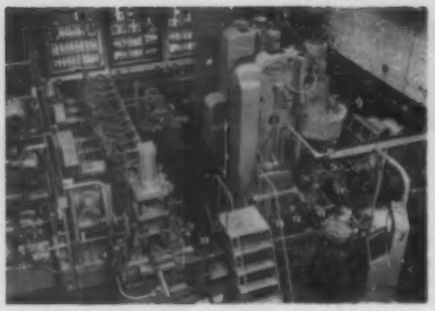
In 2,734,072, C. R. Harris of E. I. du Pont de Nemours produces acrylonitrile by contacting acetylene and HCN at reaction temperature with a catalyst consisting of an inactive support impregnated with alkali metal carbonates, hydroxides, borates, or cyanides and containing upwards of 0.2% bismuth as Bi_2O_3.

W. Reppe, W. Schweckendiek, and H. Friederich of Badische Anilin-und Soda-Fabrik, A. G. in 2,738,364 patent an improved catalyst for the production of acrylic esters from acetylene, CO and an alcohol. The catalyst comprises a complex of nickel, quaternary ammonium radical, and a radical chosen from the group of halides, cyanides, and rhodenides. W. A. Raczynski of Hercules Powder Co in 2,738,368 prepares acrylic anhydride by heating a mixture of acrylic acid, acetylene, and nickel carbonyl at 40°-100°C in an inert solvent (e.g. ethylene dichloride). Vinyl chloride is made, according to 2,730,555 assigned by L. Rosenstein to the Texas Development Corp., by charging acetylene and ethylene dichloride in mole ratio of 1.0-1.8 over a catalyst comprising 85% Hg_2Cl_2 and 15% KCl. Other conditions are 20-50 second contact time at temperatures from 200-450°F and pressures less than 4 atmospheres. The product is removed from the reactor, separated into a liquid and gas phase and distilled. Both the gas phase and the residual fraction from the distillation are recycled to the reactor.

4. Miscellaneous reactions of acetylene. In 2,718,532 (E. M. Smolin to American Cyanamid Co.) 1,1-diarylethanes are prepared by reacting acetylene with a mono-or dialkyl substituted benzene in the presence of a sulfuric acid-copper sulfate catalyst. The sulfuric acid is preferably of 88-98.5% concentration and contains about 5 wt% $CuSO_4$. Temperatures in the range —20° to 70°C are used. The same author in 2,718,533 claims the use of a sulfuric acid-vanadium pentoxidesodium sulfate catalyst for this reaction.

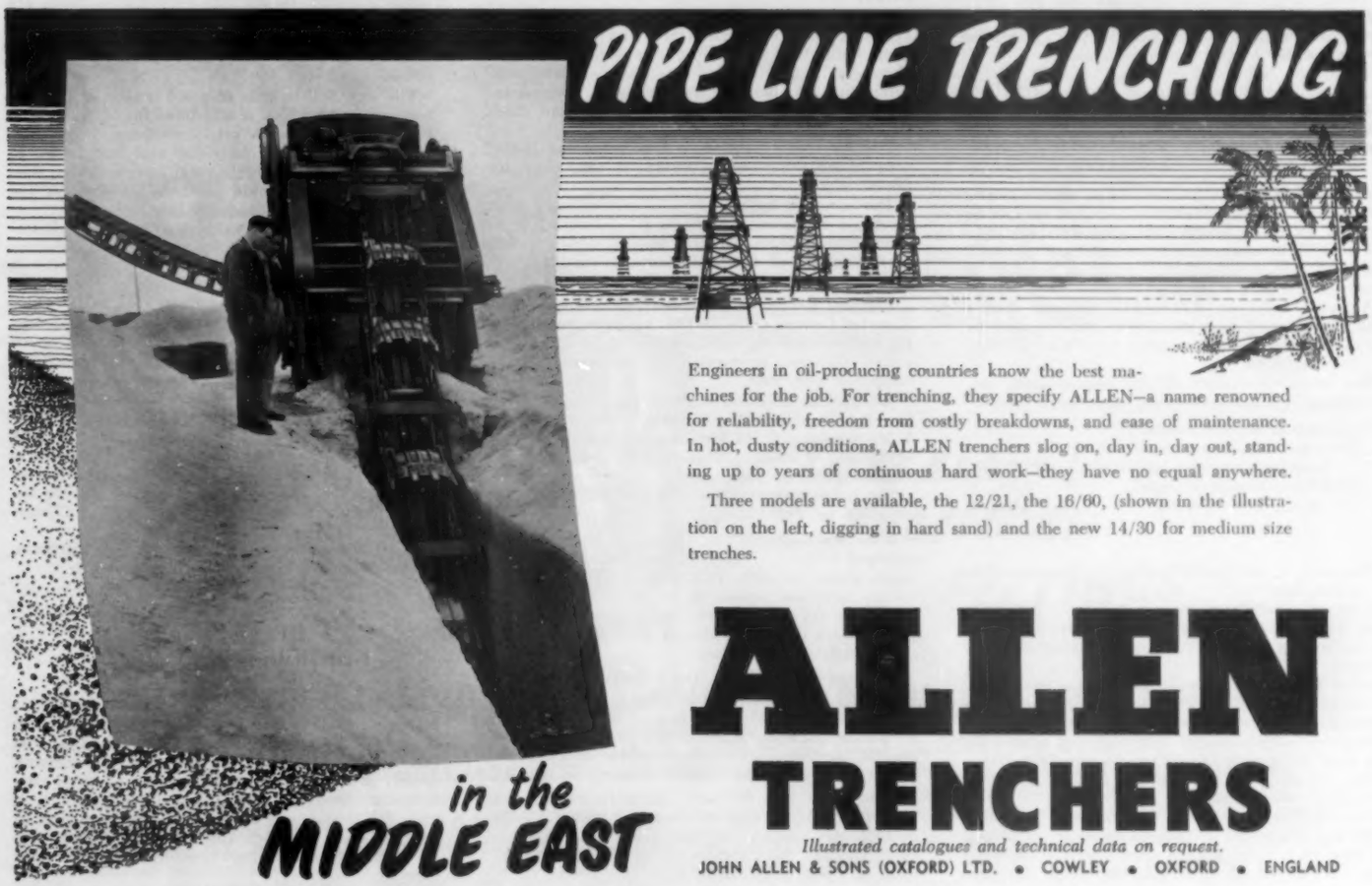
E. O. Box, Jr. (2,712,559 to Phillips Petroleum Co.) produces acetaldehyde by hydration of acetylene with steam in the presence of a zinc-zirconate catalyst. The gas and steam are reacted at 250°-400°C, atmospheric pressure to 400 psi, 100-300 volumes/volume catalyst/hr, and steam/acetylene ratios of 4-40. The process may be used for removing minor amounts of acetylene from gases consisting essentially of ethylene and hydrogen. G. W. Conklin and R. C. Morris (2,707,714 to Shell Development Co.) prepare propargyl sulfides and mercaptans by reacting an acetylenic compound, a carbonyl compound, and a mercaptan (or H_2S) in the presence of a copper catalyst. Specifically, 3,3,5-trimethyl-4-thia-1 hexyne is prepared from acetylene, acetone, and isopropyl mercaptan.

Acetylene is used to improve the catalytic hydrogenation of CO to hydrocarbons according to W. Rottig (2,738,360 to Ruhrchemie Akt. and Lurge Gesellschaft Für Warmetechnik m.b.H.). When 0.5-10% acetylene is introduced to the synthesis gas, temperatures may be maintained about 20°C lower than usual to get the same conversion. END



Transfer machine for production of precision valve bodies with operator at the master control panel. Tending toward automation, the machine replaces six other machines of various types in the production of forged steel valve bodies for Manning, Maxwell & Moore's Hancock steel valves.

Continental Oil Co. exploration men are shown in the company's new map room. View pictured is one end of the unique installation, the largest and most modern map room in the world. The Conoco staff finds the electrically-operated roller maps a big time-saver in making decisions on prospective oil areas.



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London Letter

By E. Lawson Lomax

The annual reports of several of the important British oil companies for 1955 reveal an improvement over 1954 results. For the first time in its history the gross income of the Royal Dutch/Shell group of companies has risen to over £2,000 million; the oil products sold are now nearing 100 million tons.

Net income for the year was £159,992,265, compared with the £134,474,218 in 1954, an increase of 19%. The increase resulted from greater production, refining and sales as well as improved prices. Demand for fuel oils rose sharply in Western Europe.

Group dividends totaled £33,436,000, i.e., Royal Dutch (60%) £20,061,600 and Shell (40%) £13,-374,400.

Net income of the Shell Transport & Trading Co. was £12,986,124.

The Capital Issues Committee has given Shell its consent to capitalize £16,350,408 ordinary shares, which will be allotted to ordinary stockholders credited as fully paid on the basis of one share for each £4 of ordinary stock held.

The Group Capital expenditure during the year has been £283 million, making a total of £1,081 million expended on capital account during the past five years.

This was allocated as follows:

	1955 £m	1951/55 £m
Exploration and production	124	519
Oil refineries & chemical plants	86	311
Marketing facilities	36	148
Ocean-going fleets	30	79
Miscellaneous	7	24
	283	1,081

It is interesting to note the amounts paid by the Group in dividends the last two years as against the amounts expended on capital account:

	1955	1954
Amounts paid in dividends	£33,435,000	£26,841,299
Amounts spent on capital account	£283,000,000	£226,000,000
	£283,000,000	£226,000,000

British Petroleum Co. Ltd.:—The gross trading profit of the British Petroleum group of companies for 1955 was £111,683,900 compared with £84,894,-761 for 1954. Interest on debenture stock of £976,822 and profits from subsidiary companies resulted in a net income of £46,199,539.

Amounts totalling £23,811,713 received during 1955 in respect of sums payable to the company by the other Consortium companies have been credited to capital reserve.

The amounts written off for depreciation, etc., amounting to £22,143,401, were made up as follows:

Depreciation of fixed assets:	
Land, oil wells, pipe lines, refineries, tank installations & buildings	£11,721,739
Tankers & auxiliary vessels	5,503,552
Oil exploration interests	4,918,110
	£22,143,401

The sales of the group during 1955 amounted to 48 million tons.

Refinery throughput during 1955 was 29,500,000 tons, 5,500,000 tons more than in 1954. This was mainly due to the first full-year working of Aden refinery and the start of the Kwinana refinery, together with the company's share in the operations of the Abadan refinery. The throughput of the U.K. refineries decreased by some two million tons. The throughput of continental refineries was nine million tons, as against 8.6 million tons in 1954.

The company has 41 tankers totaling 1,225,000 dwt under construction.

Burmah Oil Company, Ltd.:—Burmah Oil Co. group profit was £6,018,174 in 1955, an increase of £886,-963 over 1954. Total income after depreciation, etc., rose from £8,083,053 to £13,632,789, which was due to a certain extent to increased dividends received from British Petroleum Co. Directors recommended a final dividend of 12.5%, to make a total of 17.5% for 1955 on the ordinary capital, which was doubled to £41,209,540 by a scrip issue last year. This compares with 21% paid in 1954 on the smaller capital.

Throughput has increased at the Chauk refinery during the year, and additional wells were completed to supply crude for the rebuilt refinery at Syriam, near Rangoon, which, in the beginning, will produce mainly fuels, illuminants and wax.

Production at Nahorkatiya has increased and the refinery at Digboi in Assam is now running. The question of a new refinery to deal with the crude produced in excess of that capable of being handled by the present refinery at Digboi is being considered, as is the question of the formation of a rupee company with Indian participation to take over the development of the Nahorkatiya field.

The Sui gas field was producing natural gas at the rate of 15 mmcf daily at the end of 1955, and this production is expected to reach 40 mmcf per day by the end of 1956. A contract has been let for the laying of a further 15-inch pipe line from this field to Multan in the Punjab, a distance of 212 miles.

Work on this line will be commenced during this year and it is expected that after the completion of this length it will be extended a further 200 miles to Lahore.

The company's activities are spread over Pakistan, India and Burmah, which situation is inclined to make them somewhat complicated at times.

Lobitos Oilfields Ltd.:—Profit before taxation of Lobitos Oilfields Ltd. amounted to £714,770; after provision for taxation and adjustments, profit amounted to £440,355. Interim dividend was 6%, final dividend was 8% and a special distribution of 2% out of realized profits on investments was recommended. The same rate of interest has been paid over the past two years, but in 1954 it was on £3 million and in 1955 on £3,638,462.

Crude oil production was 522,719 tons compared with 490,338 tons for 1954, an increase of 6.6%. The Peruvian company's share from areas of joint development was 124,548 tons, so total crude oil was 647,267 tons.

Increase in production came from El Alto field, resulting from new discoveries and completion of deep wells. Loss on trading in refined products in Peru of £149,000 in 1954 was changed to a small profit in 1955, because the Peruvian government allowed price increases on gasoline, kerosine, diesel oil and fuel oil.

The refinery at Ellesmere Port processed 188,690 tons of oil, an increase of 10,890 tons over the previous year.

The company now holds £518,239 ordinary stock in Anglo-Ecuadorian Oilfields Ltd. which, for the year ending March 31, 1955, showed profits before U. K. taxation of £628,883. Accounts for March 31, 1956, are not yet available.

Trinidad Central Oilfields Ltd.:—Trading profit of Trinidad Central Oilfields Ltd. has been maintained for the year due to better quality of oil and higher prices, although production has decreased by 8% compared with 1954.

An interim dividend of 10%, less tax, was paid Dec. 9, 1955, and on May 24, 1956, a final dividend of 37.5% (making 47.5% for the year) was agreed on at the general meeting. These are the same dividends as those paid last year.

The balance carried forward was increased from £104,056 to £157,233.

Canadian Eagle Oil Co.:—Canadian Eagle has announced a div... of 1/9d. per ordinary no-par-value share for 1955. This dividend is to be paid on an increased capital of £7,532,532, making the total ordinary capital £30,130,128. Consolidated net profits were less at £7,704,149 after tax, compared with £8,004,066 last year.

Trinidad Oil Co. Ltd.:—The Trinidad Oil Co. Ltd. (formerly Trinidad Leaseholds Ltd.) has announced an interim dividend of 3d, free of income tax, per 5/-unit of stock in respect of the year ending June 30, 1956, payable to members registered on the books of the company at the close of business on May 18.

Manchester Oil Refinery directors reported a 1955 net profit of £70,058 compared with £126,773 in 1954. An interim ordinary dividend of 4% has been paid and the directors recommended the payment of a final dividend of 8½% less income tax.

Horace Stephen Gibson was appointed a Knight Bachelor in the Birthday Honors. He has been managing director of the Iraq Petroleum Co. and associated companies since 1950. After serving in World War I in France and in the Near East, he took his degree in mechanical science at Cambridge, afterwards joining the then Anglo-Persian Oil Co., becoming general fields manager in 1945. He is well known for his pioneer work on the production of oil from limestone reservoirs, and was president of the Institute of Petroleum from 1952 to 1954.

New U. K. Drilling Company Formed

A new company, Brantly-Morrison International Drilling, has registered as a private company with capitalization of £100,000 (about $280,000). Reported to have U. S. and U. K. financing, the company is engaged in drilling and exploration, but no particular areas are reported as having been selected.

To Build Rubber Plant

Esso Petroleum Co. Ltd. will build the first full-scale plants in the U.K. to make synthetic rubber on a site adjacent to the Fawley refinery. Plans are now well advanced for constructing a plant to produce butadiene from refinery gases in sufficient quantity to supply the requirements of the new rubber factory.

The unit will be part of a £9 million chemicals-from-oil plant which is scheduled for completion in 1958. It will process crude naphtha to produce ethylene, propylene, butylene and butadiene. In addition to these petrochemical intermediates, Esso will manufacture liquid products suitable for the manufacture of resins, paints, etc.

In addition to Esso's venture into the petroleum-chemical industry, other schemes in this direction are well advanced. At its Wilton Works, I.C.I. is building a second thermal naphtha cracker which will double the plant capacity to 200,000 tons throughput per annum. A 10,000-ton synthetic rubber plant is also being built, which will be supplied with butadiene from the cracking plant. This scheme is due for completion in 1956 at a cost of £5 million.

A project is in band at I.C.I.'s Billingham factory for the manufacture of ammonia from heavy oil.

Other projects which have been reported previously in WORLD PETROLEUM are the developments at the British Hydrocarbon Chemicals plant of British Petroleum Co., Ltd. at Grangemouth as well as the developments being carried out by the Shell Chemical Co.

In all, these various developments will cost more than £30 million in the next three years.

BP To Supply British European Airways

The British Petroleum Co. has been awarded a contract to supply all the aviation fuel requirements of British European Airways Corp. for the next three years. The contract covers over 60 airfields, mainly in Britain and on the continent, and is estimated to be worth approximately $23 million. It calls for the supply of nearly 3,500,000 barrels of aviation fuels, of which about 2,800,000 barrels will be turbine fuel and approximately 650,000 aviation gasoline.

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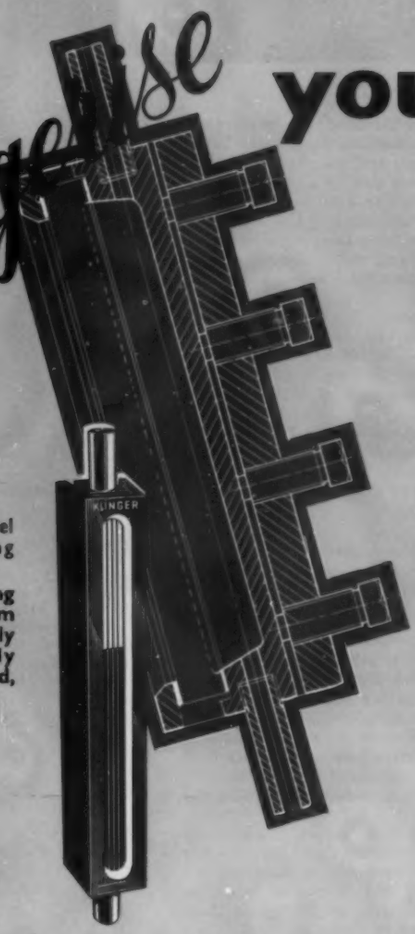

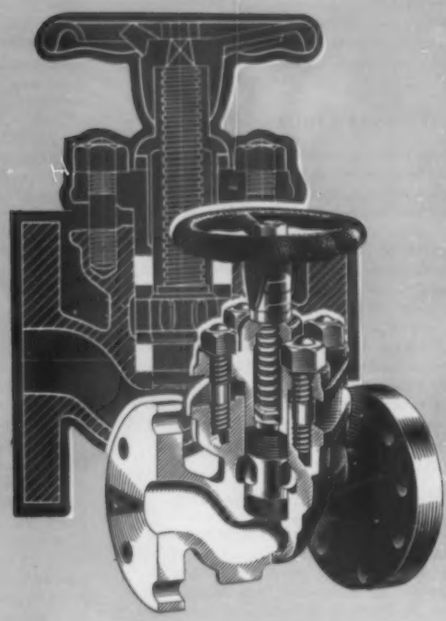

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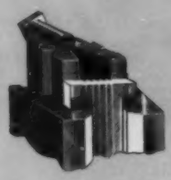

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The Klinger Seatless Piston Valve operates on an entirely different principle from the usual type of seating valve. It consists basically of a finely ground piston, operated by the valve spindle and hand wheel, and moving through two or three non-metallic resilient valve rings, capable of resisting steam, oil and most fluids at high temperatures and pressures, and separated by a ported lantern bush. It is made in a great variety of sizes and designs, to suit all purposes, and has the following advantages:—

No seat—consequently no regrinding. Can be serviced in the line. Unaffected by wiredrawing. Unaffected by throttled use.

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In the last quarter of a century Klinger Sleeve-Packed Cocks have steadily replaced the old-fashioned asbestos-packed cocks with their limitations of working pressure, difficulty of repacking, and tendency to jam. They are available in a wide range of designs and sizes for all purposes, and with the following advantages:—

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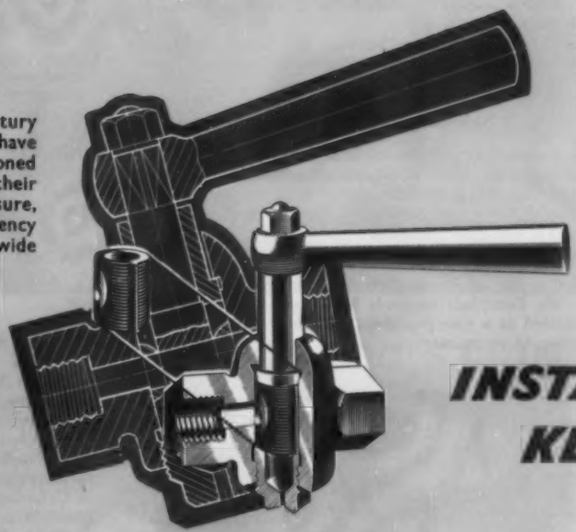

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Latin American Oil News

U.S.S.R. Barter Offer

Premier Bulganin stated recently that the USSR should have "very extensive relations (with Latin America) in petroleum, mining and electrical power." A previous statement to Mexico offered Russian petroleum equipment and products in exchange for coffee, sugar and fruits.

Venezuela Accepts Concession Bids

Concession bids were accepted in Venezuela on June 9 when 11 lots, covering about 271,810 acres in Lake Maracaibo, were opened up.

Some 25 companies have been awaiting a chance to bid on Venezuelan concessions and an undetermined number of these handed in their sealed final bids. The 11 concessions are all for exploitation and therefore not subject to the 50% reduction which automatically occurs under Venezuelan law when exploration concessions are converted. The minimum price per hectare was 4,000 bolivares, which averages $483.20 per acre. Since each concession was about 24,710 acres, the minimum was around $12 million. Bids undoubtedly exceeded this minimum, however, because the area adjoins producing areas held by Shell and Creole companies.

Mexican Pipe Line Construction

A number of oil pipe line ventures are being completed in Mexico. A 50-mile crude oil line of 16 inches diameter and running from Angostura to Veracruz port is to be completed this year. The capacity is to be 25,000 b/d. A 304-mile products pipeline of 12 inches diameter is being laid from Tampico to Monterrey, to have an initial capacity of 25,000 b/d. The line is so built that the capacity can be doubled.

The line to Monterrey is awaiting the completion in June or July of terminal storage facilities at Monterrey. When built, the line is expected to solve severe distribution problems, which have seen Pemex carrying 50% of its products sold in Monterrey by "expensive" railroad.

A new line from Poza Rica to Atzcapetzalco, of 4.5 inches diameter, has been laid to carry 3,000 b/d of propane. An 18-inch line to carry 115,000 b/d of crude runs from Poza Rica to Atzcapetzalco. The refinery at Atzcapetzalco is being built up to double its capacity to 100,000 b/d. A trans-Isthmus pipe line, from Minantitlan to Salinas Cruz, is being doubled to carry 30,000 b/d.

Texaco Purchase Disputed

The Texas Company's purchase of Trinidad Oil Ltd. for $176 million aroused strong opposition in the British Parliament. The Trinidad company had production of 18,735 b/d in May of this year and refined about 76,479 b/d in 1955. It markets with Caltex in England. The company's chairman stated the sale was in the best interests of British colonialism and that Trinidad Oil alone did not have the financial strength necessary to a proper expansion in keeping with growing oil demand. The sale was approved by the British Parliament during late June.

May Admit Foreign Companies

Col. Janary Nunes, president of Petrobras, the Brazilian Government oil monopoly, is pleading for two more years for Petrobras to show what it can do, in a recent report.

After that, he says, the basic petroleum legislation could be re-examined if Petrobras has not solved its major problem of finding more crude petroleum. He said that Brazil plans to export much of her valuable high-paraffin crude oil, which is worth $4.50, and use imported oil at $3 a barrel, as a way of saving dollar exchange. He also pointed out Mataripe refinery in Sao Salvador is to be increased by 1958 to 37,000 b/d throughput, using 15,000 b/d of Bahia crude for lube oils and paraffin.

The well at Nova Olinda will be a pumper, as are most oil wells, for oil rose to 2,400 meters, and the depth was 2,757 meters, according to Col. Nunes. He further stated that feelers have been made to foreign oil companies to carry on oil well drilling programs, with payment on a footage basis or on a crude oil royalty basis.

Other points made were:—Brazil's refineries are saving $20 million a year in U. S. dollars in foreign exchange. By 1960, some 200,000 b/d of crude is to be refined in Brazil. Artur Bernardos (Cubatao) refinery had a profit last year of CR$480 million on a cost of CR$2 billion.

The 1956 profit of Petrobras is estimated at CR$3.5 billion, much of which is to be used for exploration and development. The company plans to double its capitalization by another CR$8 billion.

Brazil's Productive Capacity Raised

Footage drilled in Bahia Reconcavo this year to April 30 totals 64,126 ft. Total drilled to date (since 1939) is 890,369 feet. 476 wells have been drilled, of which 301 are producing oil, 35 gas and 101 are dry. 14 are to be injected with salt water to maintain pressure in Dom Joan field. Eight fields in the Bahia Reconcavo area are producing oil, two natural gas. Reserves are given officially as 255,000,000 bbls. Petrobras plans to drill over 80 wells this year, using 16 rigs. The productive area of Candeias field was extended when oil was found in April at 5,200 ft. in exploratory well 96, thought to be outside the field limits.

On May 10, President Kubitscheck inaugurated the 32.4 mile pipe line connecting Catu, Mato de Sao Joao, Pojuca and Candeias fields to Mataripe refinery. Capacity is 12,000 b/d. It can be raised to 22,000 b/d. A marine terminal on Madre de Deus Island will be completed in June and will allow 3,000,000 barrels of crude to be shipped to southern refineries this year.

Five experts from Seismograph Service Corporation reached Belem for Petrobras in May.

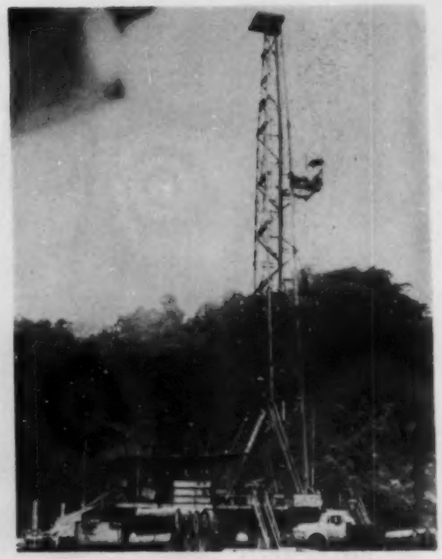
Siboney Name Changed

Siboney Development and Exploration Co. has changed its name to Siboney-Caribbean Petroleum Co. The announcement stated that the new name would more closely identify the business.

NICHOLAS J. CAMPBELL, JR. has been elected a director of Creole Petroleum Corp. May 1.

Mr. Campbell succeeds Mr. Lloyd G. Smith who retired as a vice president and director on April 30 after 43 years service.

Nicholas J. Campbell



The first Central American oil well to establish that petroleum exists in the area is located deep in the Costa Rican tropical jungles near the Panama border. The well, pictured above, is the Cocoles #1 well, of the Union Oil Co. of California, which has good oil shows following the drilling of four dry wells at a cost of $5 million. The company is preparing to drill other wells immediately to test the extent of the oil field. Drilling operations are hindered by heavy tropical downpours that often isolate the well from civilization for weeks at a time.

Venezuela Drilling

A total of 1,148 wells were drilled in Venezuela during 1955 for oil and gas, according to reports reaching official U. S. channels.

	OIL		*GAS*		*DRY*		*TOTAL*
	A	*B*	*A*	*B*	*A*	*B*	
Creole	110	13	2	—	7	21	153
Mene Grande	215	20	3	1	13	15	267
Shell group	349	5	—	1	3	4	362
Sinclair	29	8	1	—	4	6	48
Texas	17	1	—	—	4	2	24
Mercedes	33	4	1	—	13	15	66
Socony	40	1	—	—	—	2	43
Atlantic	18	5	—	—	11	22	56
Phillips	47	1	—	1	1	—	50
Richmond	53	—	—	—	1	—	54
Pantepec	9	—	—	—	—	—	9
Talon	12	—	—	—	2	1	15
Core	—	—	—	—	—	1	1
Total	932	58	7	3	59	89	1,148

NOTE: A—Development
B—Wildcat

New Procon Subsidiary

Procon Inc. has announced formation of a new subsidiary, Procon International, S.A., to handle its petroleum process construction activities outside the United States.

The new corporation's first major assignment is to construct all facilities for a 20,000 b/d refinery in Cuba for The Texas Co. The firm will have headquarters in Chicago and a branch office at Santiago de Cuba. Activities will be mainly in South America.

Argentina Pipeline Capacity Up

To increase transportation facilities for the Mendoza crude oil production, Y.P.F. has decided to add to its oil pipe lines from Tupungato-Agrelo and Barrnacas-Lujande Cuyo another line from Barrnacas to Palmira with a length of 22 miles. This will reduce rail transportation by 1 to 2 days, increasing tank wagon capacity to the San Lorenzo refinery by 15 to 20%.

BP DRILLS 1,000,000 FT. IN BRITAIN

TWENTY YEARS AGO The British Petroleum Company started the search for oil in Britain and began production in 1939 to make a timely addition to wartime supplies. Now more than a million feet have been drilled in Britain by the BP Group.

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In 1955 some 394,000 barrels of crude oil came from Britain's 223 producing wells—most of them in the Nottingham area—bringing up the total quantity produced from English oilfields to 6,750,000 barrels. A very worthwhile contribution to Britain's ever-growing need for oil and oil-products.

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Canadian Notes

Canadian Pipe Line Construction Rising

A round-up of oil and gas pipe line projects planned or under way in Canada indicates this is likely to be "quite a year."

Trans-Canada Pipe Lines Ltd. got started in June on construction of the Alberta-Winnipeg leg of a natural gas line destined for Ottawa.

Westcoast Transmission Co. is stepping up work on its gas line from Peace River area to Vancouver. The company aims at start of carrying gas in 1957. The cost is $153 million.

Northern Natural Gas Co., Omaha, has proposed an Alberta to Edmonton to Montana to St. Paul, Minn. line.

Britalta Petroleum Ltd. hopes to build a pipe line from the Alberta border to supply gas to Swift Current, Moose Jaw and Regina, Sask.

Cremona Pipeline Ltd., a subsidiary of Home Oil Co., a leading Canadian independent, has approval from the Conservation Board for an oil pipe line from Sundre-Westward Ho-Harmattan field to Calgary. Cremona was in competition with Hudson's Bay Oil and Gas Co. and Pembina Pipe Line Co., which proposed lines to Edmonton.

Hydrocarbons Pipeline Ltd., a subsidiary of Canadian Hydrocarbons, Ltd., of Winnipeg, expects to build a $35 million 800-mile system to carry oil and gas products from Alberta to Manitoba. The line would start near Edmonton, go through Saskatoon and Brandon to Winnipeg.

Canadian Gulf Pipeline Co. is proposing a $736,000 pipe line of 35 miles from Drumheller oil field North to Big Valley to connect with existing Gulf pipe line to Edmonton. Canadian Gulf Pipeline Co. also is proposing a seven-mile line from the Burbank field, five miles north of Red Deer, and Joffre field to join a line to Interprovincial at Edmonton. Three other companies have conflicting proposals.

Westspur line in Saskatchewan is to start early in June. Sturgeon Lake line in Alberta's Peace River area is another project. Interprovincial Pipe Line Co. has agreed with British American for extension of its line from Edmonton 150 miles to Clarkson, Ontario, where British-American has a refinery.

Two proposals to construct pipe lines in southern Saskatchewan are being considered by the Oil and Gas Conservation Board. South Saskatchewan Pipe Line Co. of Regina has applied for a permit to construct a line from the Dollard to Cantuar oil field in southwestern Saskatchewan which connects with an existing line running from Cantuar to Regina.

Royal Pipe Lines Co. Ltd., of Regina, plans a collecting lateral system from the Cantuar-Fosterton-Success-Battrum field area, and a trunk line from an intersection with the lateral at the Dollard field easterly to the Midale field area, and then northerly to make connection with the Interprovincial Pipe Line System at Glenavon, covering some 288 miles in total length.

Canadian Kellogg-Toronto Iron Works

A new company, T. I. W. Western Ltd., has been formed by Toronto Iron Works Ltd., and Canadian Kellogg Co. Ltd. The new firm will incorporate the former Canadian Kellogg manufacturing shops in Edmonton. Toronto Iron Works will service its western customers through the new company on the fabrication of both storage tanks and various lines of steel and alloy-steel plate products. All fabricating services introduced by Kellogg will be continued and the present Edmonton facilities will be expanded to permit the fabrication of the additional products required to accommodate Toronto Iron Works' western clients.

G. E. Ellsworth is president, D. W. Champlin, vice-president; and R. T. Valentine general manager. The present staff at Edmonton will be retained.

Parliament Approves Trans-Canada Loan

The world's largest pipe line has finally received a loan from the Dominion government. The loan will cover 90% of the cost of construction (up to $80 million) of the 34-inch line from Alberta to Winnipeg. The liberal government of Prime Minister St. Laurent faced a stormy session in Parliament which included charges of selling out of Canadian interest to Americans. The rule of closure was invoked by the government several times to limit debate for the first time in 24 years.

Trans-Canada, headed by N. E. Tanner, president, was ready to move immediately when the loan approval was received Wednesday, June 6th, only a few hours before the deadline. Six spreads are in operation, each with about 250 men laying around a mile of pipe a day. The line should arrive on the target date of October 31 to Winnipeg.

About 1,000,000,000 cubic feet will be required just to fill the line to Winnipeg. Initial market in Winnipeg, the first stop in Trans-Canada's way to Eastern Canada, will be around 21,000,000 cubic feet, far below the 640,000,000 cubic feet potential of the line, and far below the announced market of 300,000,000 cubic feet which Trans-Canada has signed or has in prospect in eastern Canada.

These larger markets cannot be reached, however, until the remainder of the 2,250-mile line is built, and there are large obstacles still in the way. One of these is the pending Federal Power Commission approval of Trans-Canada's building an export line into the U. S. for sale of 200,000,000 cubic feet daily to Midwestern Gas Transmission, a subsidiary of Tennessee Gas Transmission. Local gas and coal companies are fighting the approval, without which the commercial feasibility of constructing the line across the sparse markets of central Canada to the East is dubious.

The next step, however, seems to be assured. A crown corporation will build the 675-mile stretch to Ontario, with money contributed by the Federal and provincial governments and the line leased to Trans-Canada.

Producers within Canada will receive 10½ cents per mcf at the wellhead. Bindloss field will supply enough gas for the first year, with sufficient pressure to carry to Winnipeg.

Canadian Crude Runs To Stills Up

Crude received for refining in Canada during the months of March amounted to 17,123,257 barrels, according to the Canadian Petroleum Association. Deducting closing inventories for the month, this leaves a total of 16,669,201 barrels consumed, allowance made for storage losses in a few instances.

The amount consumed is estimated to have decreased slightly in April, to 16,367,000 barrels. During May and June amounts rose sharply, according to CPA estimates, to 18,582,500 barrels and 19,179,000 barrels respectively.

Of the March total runs, 9,765,553 barrels came from Canadian fields. The remainder was imported, principally into the big refining provinces of Quebec and Ontario. Receipts from foreign sources were mainly from Venezuela, which furnished 15,667,363 barrels during the month, while the Near and Middle East furnished 1,151,092 barrels. Trinidad furnished 11,916 barrels and the United States furnished 427,333 barrels.

New Petroleum Regulations in Saskatchewan

A revision and consolidation of the Petroleum and Natural Gas Regulations under the Mineral Resources Act has been published in the Saskatchewan Gazette No. 17, Vol. 52, dated April 29, 1956. The regulations are a complete consolidation of all the old regulations governing the disposal of petroleum and natural gas rights. Every oil and gas operator in the province will be provided with a copy of the regulations, according to J. H. Brockelbank, minister of natural resources.

The new regulations are divided into 8 parts, according to the industry phase to which they pertain, covering exploratory permits, drilling reservations, leases, etc.

Canadian Income Taxes

(*Continued from page 69*)

There is, however, no provision for depletion based on cost.

An operator is defined as one who has an interest in the proceeds of production from an oil or gas well under an agreement which provides he shall share in the profits remaining after deducting the costs of operating the well. Under this definition taxpayers in receipt of income in the form of gross royalties are classified as non-operators, whereas taxpayers who have a direct working interest in oil or gas wells, or who have income from carried interest or net royalty interests, are considered to be operators.

The rates of depletion are 25% in the case of non-operators and 33⅓% to operators. In arriving at profits subject to depletion for operators, the Department of National Revenue has contended that the revenue from all wells must be grouped and all drilling and exploration expenses (productive or non-productive) which have been claimed in arriving at taxable income must be deducted from this total. This interpretation has the effect of denying depletion in the case of operated wells until all drilling and exploration expenses in all areas have been deducted and in effect postpones the depletion allowance indefinitely for those companies which are spending a large part or all of their income on drilling and exploration activities.

Some operators feel that the Department's interpretation is incorrect and that a correct interpretation of profits subject to depletion is the profit from each individual well after deducting the drilling expenditures applicable to that well only. Notwithstanding efforts by the Department since 1950 to tighten the depletion regulations, it is felt in some legal circles that the Court's decision may be the basis of successfully claiming well by well depletion in years subsequent to 1950. However, this is a matter which will only be decided by reference to the courts.

There can be no doubt that the Department of National Revenue's interpretation of the depletion regulations, together with the lack of cost depletion, results in a much less generous depletion allowance in Canada than is available under United States law.

As far as Canadian taxation is concerned, operating results in Canada of both Canadian and United States corporate operators receive identical treatment. A United States operator receives the same allowances for United States tax purposes as though his Canadian expenditures were being made in the United States and therefore, until such time as his cumulative Canadian income exceeds his cumulative Canadian expenditures, Canadian income taxes are not relevant. However, after the United States operator becomes liable for taxes in Canada, his total tax bill will probably be somewhat higher as a result of less favorable Canadian depletion allowances.

The information contained herein has referred entirely to corporations.

EDITOR'S NOTE: *Canadian income tax law has been recently changed to keep the absorbed company alive for tax purposes and permit deduction of its exploration expenses from taxable income, a modification often suggested within Canada.*

Canadian Mud School

Drilling, production and mud engineers from Imperial Oil, Ltd., Texaco Exploration, Stanolind Oil and Gas and Shell Oil, spent the week of May 7 attending a "Mud School" conducted jointly by Oil Base, Inc., Compton, Calif., and Pacific Western Mud Service, Ltd., Canadian distributor. Classes were held at Pacific Western's labs in Calgary. Jack Long, vice president of Oil Base, conducted the series of lectures, assisted by Clint Buffington, chief engineer of Pacific Western.

Imperial To Build in Edmonton

Imperial Oil Ltd. will build a $1 million office building in Edmonton to house its pipe line purchasing, medical and Alberta marketing staffs.

Construction of the three-story structure on the southwest corner of 109 Street and Kingsway will begin immediately. It is expected to be completed in the fall of 1957.

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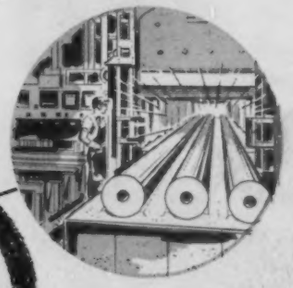

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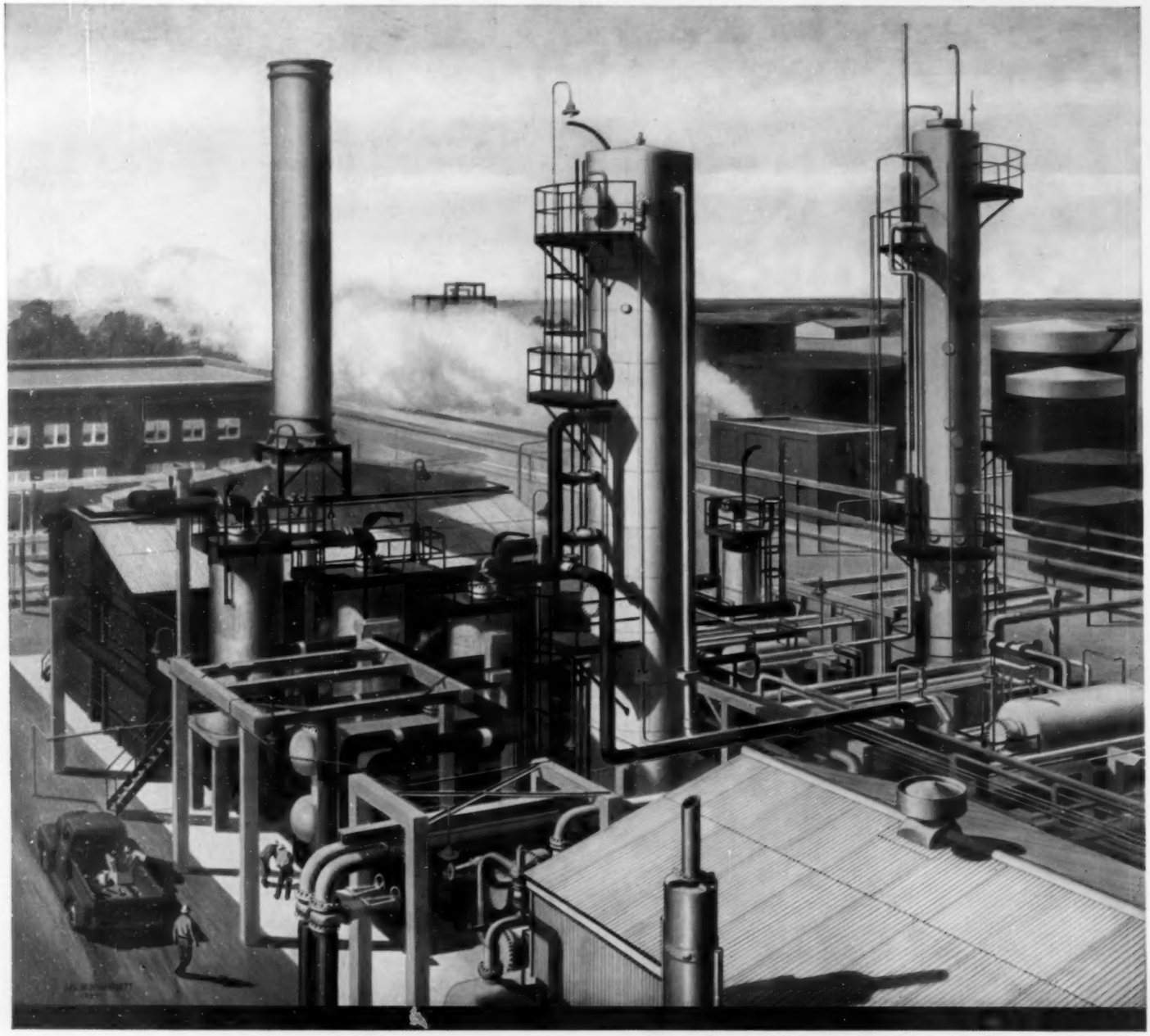

CROWN CENTRAL REFINERY

Crown Central Petroleum Corporation's new Houdriformer at its Pasadena Refinery near Houston, Texas is designed primarily for upgrading naphthas to produce high octane motor gasoline. Further processing makes possible the commercial production of aromatics and aviation blending stocks.

A feature of the Crown Central catalytic reforming unit is a "guard case" to desulphurize and pre-treat charge stocks. This small reactor is an integral part of the Houdriformer unit and strips the stock of contaminants, thereby eliminating the need for complicated pre-treating processes.

A new brochure on the Houdriforming Process is available on request. Write to: Houdry Process Corporation, 1528 Walnut Street, Philadelphia 2, Pa.

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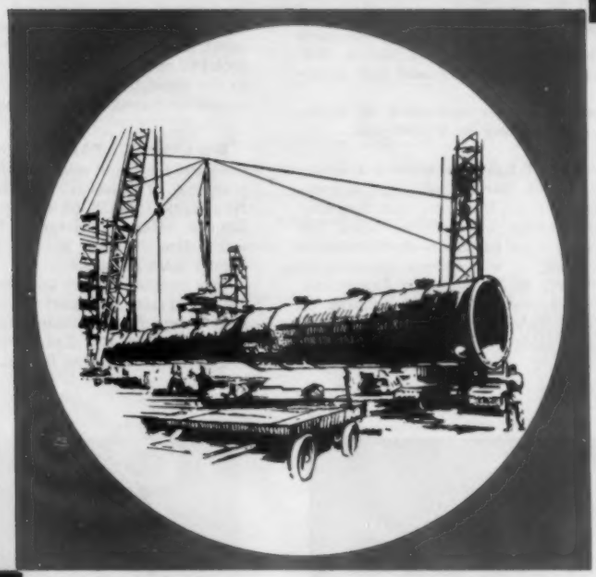

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UNITED AIR LINES

William K. Warren

WILLIAM K. WARREN has been elected a director of Gulf Oil Corp. In 1916, Mr. Warren had worked for the Gypsy Oil Co., then a subsidiary of Gulf. He left to found and develop Warren Petroleum, which merged this year with Gulf.

MARVIN A. BOMER has been elected a vice president of Eastern States Petroleum Co., Houston. He is general manager of refineries. Ray G. Granlund was named senior vice president. Edward J. Fourtiq was named vice president in charge of petroleum sales.

T. RIEBER has been elected to the newly-created office of chairman of the board of Barber Oil Corp., and vice president James H. Durbin succeeds Mr. Rieber as president.

Mr. Rieber will continue to be the chief executive officer of the corporation and Mr. Durbin will direct and coordinate operations and administration. Mr. Durbin was a director and officer of American Republics Corp. for many years and was its executive vice president when it was dissolved in March, 1955. Since then he has been a director and vice president of Barber.

The stockholders of Barber re-elected all directors at their annual meeting in Wilmington.

CLAUD B. BARRETT has been elected a director of The Texas Co. Mr. Barrett, who is vice president for the company at Houston, was formerly vice president in charge of domestic sales. He joined the company as a salesman in Atlanta in 1927. In August, 1938, he was named manager of the southern territory at Houston. In September, 1953, he was elected vice president in charge of domestic sales with headquarters in New York, and became vice president at Houston in January, 1955.

Albert F. Lager

ALBERT F. LAGER has been appointed resident manager of the Oasis Oil Co. of Libya, a wholly-owned subsidiary of the Ohio Oil Co.

SERGE JURENEV has been appointed chief economist and assistant to the president of Continental Oil Co. He was formerly assistant to the board chairman. He joined the company in 1942. For a time, Mr. Jurenev was consultant to the Paley Commission of the Cabinet Committee on Energy Supply and Resources.

JAMES H. GARDNER, JR., has been appointed representative at Wichita, Kansas, for Garvey Drilling Co., Mr. Gardner was formerly with L. B. Jackson Drilling Co. at Tulsa and prior to that was active for nine years in the oil investment field.

K. E. BEALL, vice president, economics department, has been appointed vice president and petroleum consultant of Phillips Petroleum, reporting to the executive staff. C. E. Turner has been promoted to manager of the economics department.

WILLIAM C. TALBERT has been promoted to the newly-created position of assistant export sales manager of Mission Manufacturing Co. Leaving New York June 28, he will be stationed at Mission's London office, 17 Hanover Square, W.1, and will work directly with R. L. (Jack) Faris, Mission's export sales manager.

This appointment is another step in the continuing expansion of export activity by Mission. Other recent steps have included the formation of Mission Manufacturing Co. Ltd., with offices in London, England, and plant at Belfast, Northern Ireland.

Claud B. Barrett

William C. Talbert

Throughout the World

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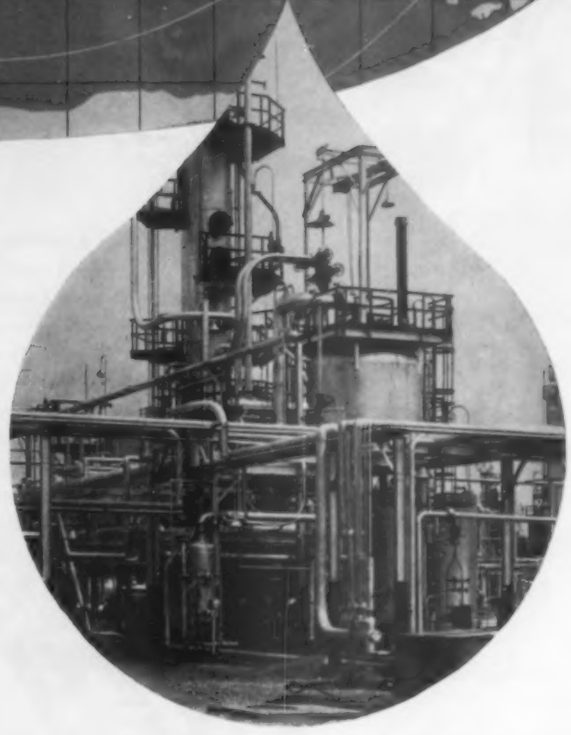

Hydrofining unit, Esso refinery, Fawley. This is one of the many plants using Spence catalyst. Photo by courtesy of Esso Petroleum Company.

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SEISMIC GRAVITY MAGNETIC SURVEYS

T. C. Lemcke

New Reed Roller Bit Representative

T. C. Lemcke has been named technical representative of the Reed Roller Bit Co. in London. Mr. Lemcke is now making a four months trip to oil operations in the Near East and Middle East. He and his family will take up residence in London in mid-summer.

Singer B. Irelan

Singer B. Irelan, 67, a director of Cities Service Co. and president and a director of Cities Service Oil Co. (Del.), died June 18 following a brief illness.

He had been associated with Cities Service since 1909 and was one of the nation's outstanding figures in the electric utility, petroleum and natural gas industries.

Mr. Irelan was also president and a director of Cities Service Oil Co. Ltd., Cities Service Gas Development Co., Cities Service Production Co. and Cities Service Pipe Line Co. & Lafitte Oil Traders, Inc. He was also executive vice president and general manager of Canada-Cities Service Petroleum Corp., as well as a director of Cities Service Petroleum, Inc.; Empire Gas & Fuel Co.; Texaco-Cities Pipe Line Co.; Richfield Oil Corp.; Great Lakes Pipe Line Co.; Cities Service Pipe Line Co.; and The First National Bank and Trust Co., Tulsa. He was a trustee of the Midwest Research Institute of Kansas City.

Named Managing Director

A. A. Lodigensky has been named managing director, exports, for H. K. Porter Co., Inc. His headquarters will be in the firm's New York offices at 300 Park Avenue.

Otis Buys Bryan Gas Lift

Otis Engineering Corp., manufacturing affiliate of Otis Pressure Control, Inc., has purchased the Bryan Gas Lift Equipment Co. The Fort Worth firm was founded 30 years ago by its president, Thomas E. Bryan, who has been a pioneer in the development of gas lift equipment and who originated the idea of retrievable gas lift valves. He will remain with the company as a consultant.

Many of the basic patents on gas lift equipment are still held by the company, and much of the equipment is designed to operate with Otis wire line tools for permanent well completions.

Cardwell Appoints Courtney

John W. Mecom of Houston, owner of Cardwell Manufacturing Co. located in Wichita, Kan., today announced the appointment of Paul Courtney as general manager of Cardwell. Mr. Courtney recently resigned as president and director of the George E. Failing Co., Enid, Okla.

Mr. Courtney has been associated with the oil industry for many years and spent considerable time in foreign operations with Shell Oil Co. He was formerly vice president of Emsco Manufacturing Co. and was president of Unit Rig and Equipment Co. prior to his association with Failing.

Worthington/Mason-Neilan Merger

Hobart C. Ramsey, chairman of Worthington Corp., and Eldon MacLeod, president of the Mason-Neilan Co. of Boston, Mass., have announced an agreement for the transfer of the net assets, name and goodwill of Mason-Neilan to Worthington in exchange for Worthington common stock. The agreement went into effect on or about March 30. The Mason-Neilan plant and facilities will be operated as the Mason-Neilan Division of Worthington, and the entire working force and management staff will be continued in their present positions.

Belgian Oil Equipment Council

The Council of Belgian Manufacturers of Petroleum Equipment held a 3-day study meeting at Liege on May 2-4. The degree of equivalence of carbon steels as produced in various countries and the results of preliminary examination of two grades of carbon steel in crude oil tanks were among the subjects discussed. An European tentative specification for the construction of horizontal mild steel storage tanks was put forward, and specifications for the construction of welded storage tanks and the API-ASME code for the construction of unfired pressure vessels were examined from the European viewpoint. Details of the meeting are obtainable from the Council at 21 Rue des Drapiers, Brussels.

Well Gauging Tank

Holsclaw Bros., Inc., Evansville, Ill., has developed a mobile well gauging tank for small producers. Built on a trailer, the gauge tank is equipped with a propane heater for emulsion breaking and graduate glass for accurate measurements.

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ENGLAND

H. W. Brown

Merrill W. Haas

H. W. BROWN has resigned as a director of The Carter Oil Co. to become the representative for Europe and Africa on the New York staff of the coordinator of producing activities, Standard Oil Co. (N.J.). Merrill W. Haas, exploration manager, was elected a member of the Carter Board. He will continue as exploration manager.

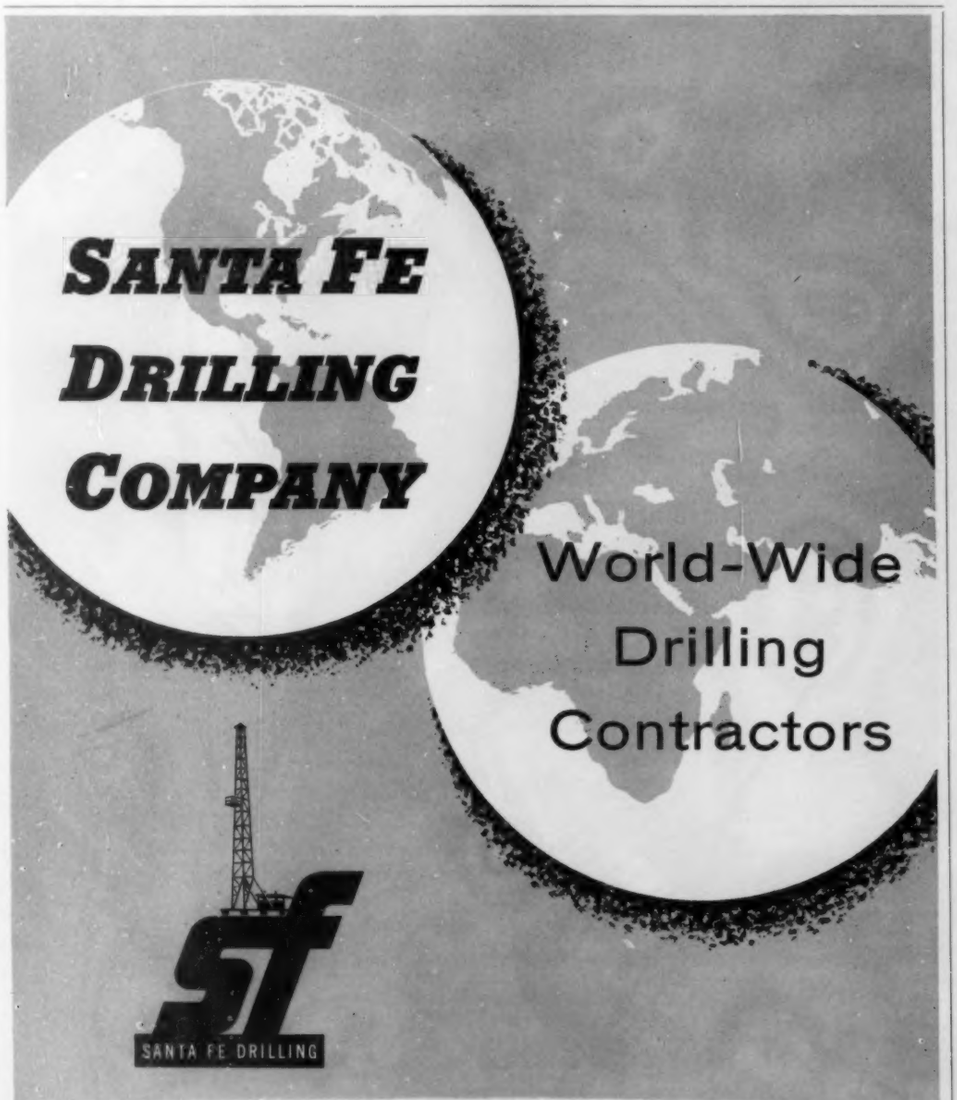
Robert H. Greenwood

Robert H. Greenwood, 35, Alexandria, Egypt, assistant controller of Sahara Petroleum Co., a subsidiary of Continental Oil Co., died May 21 in Cairo, Egypt, a victim of bulbar poliomyelitis. Mr. Greenwood was with Continental Oil Co. at Ponca City, Okla., for four years before becoming assistant controller of Sahara Petroleum Co. in Egypt in 1954.

Self-Propelled Barges

New York Shipbuilding Corp. and Dresser Industries have joined forces to produce offshore drilling barges. Initial project is the construction of two vessels at a cost of $3.5 million for the Coastal Marine Drilling and Construction Co., Houston.

One of the two vessels is a supply ship and the other a 272-foot self-propelled drilling tender powered by a 3,150 hp diesel electric unit. The tender is designed to be anchored beside a permanent drilling platform for offshore work. The 132-foot supply ship has a loaded capacity of 605 tons.



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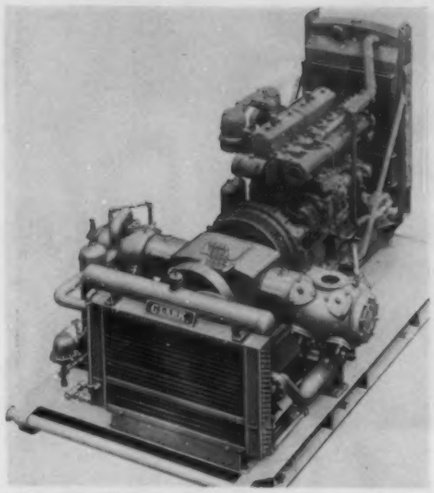

New Clark Model CFA packaged gas-engine-driven field compressor.

Packaged Compressor

A new CFA packaged compressor has been designed by Clark Bros. Co., one of the Dresser Industries, for gas gathering, gas lift, and other applications requiring a unitized compressor station in the 75-200 range.

The unit consists of a newly-designed Balanced/Opposed compressor which is mounted on a steel skid and is direct-driven by an oilfield-type gas engine. A radiator is included to permit intercooling of the gas between stages and also to cool the lube oil and compressor cylinder jacket water. A scrubber and dump trap can also be provided to remove condensate and moisture from the gas stream between stages.

The compressor is of 5-inch stroke and has two horizontally-opposed compressor cylinders which project from opposite sides of the crankcase. The unit features the Balanced/Opposed principle perfected by Clark and used on the larger 8-, 14-, and 17-inch stroke Balanced/Opposed compressors in which, as a result, the CFA is claimed to be virtually vibrationless in operation.

New Dresser Washington Office

Urban Niblo, brigadier general (retired), has been appointed director of government operations with offices at 401-08 The Folger Building, Washington, D. C., for Dresser Industries, Inc., of Dallas.

The office will handle Dresser's expanding foreign operations and domestic governmental activities.

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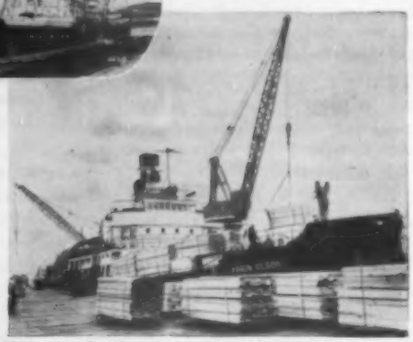

The net results of converting from old type rigging: Speeds up cargo handling — reduces idle port time — cuts maintenance cost. These self-contained MARINERS operate independently of ship's power.

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California Tidelands Development

(Continued from page 83)

formed a ring of concrete around the island inside the interlocking steel piling that forms its perimeter.

All cellars are equipped with water-tight doors opening onto a catwalk that encircles the portion exposed to the ocean or have permanent openings out to the wharf. Each cellar is provided with a device to detect dangerous gas concentrations. Each cellar is also piped for foam and fog fire extinguishers with overhead nozzles. Means are also provided for the instant automatic shutting off of all wells and all cellars should there be a break in the flow line. Manual controls are also provided. Enlargement of the Belmont project without increasing the diametrical size of the island is an important step in the development of this type of operation and is an example of the ability of the oil industry to adapt itself to any situation. Offshore drilling is expensive and economies are therefore very important and necessary.

The bane of operators in the Wilmington field, and especially the Long Beach Harbor section of the field, are the periodic earthquakes because usually this results in damaged wells. This means extensive redrilling work and in some cases abandonment of producing wells. In 1955, this field was still repairing previous damage resulting from pinched casing. Earthquakes in December, 1947, November, 1949 and August, 1951, wreaked the most havoc. The earthquakes of 1947 and 1949 had their epi-centers on Terminal Island but the 1951 earthquake affected that area north of Terminal Island. Note especially that these earthquakes occurred at approximately two-year intervals. There have been other earthquakes since 1951 but remedial measures undertaken since 1951 have apparently alleviated the problem to some extent. It has been estimated that earthquakes and the resulting subsidence and compaction have caused damages aggregating $20 million, not including lost production.

Every well drilled in the subsidence and compaction area is a calculated risk because there is no way of determining how long a well will continue to produce. This risk has been reduced to some extent, however, by the present practice of drilling bell holes with diameters ranging from 26 to 30 inches and filling the interval between the wall of the hole and casing with a shock-absorbing gel which will also soften the shock from a counter-clockwise shearing. These bell holes have apparently protected well casings for several years but every once in a while one of these wells goes bad. It is difficult to fully appreciate the tremendous pressure generated by this mass of earth.

It is quite obvious that large-diameter holes have proved highly efficacious but in recent months operators are beginning to realize the possibility that some well casings are no longer centered in the bell hole and that sooner or later additional wells will require remedial work. This suggested assumption reflects the fact that wells with bell holes and gel have been going bad from time to time. This is indicated by the fact that some wells have been redrilled twice. Operators usually back up to 300-500 feet and begin opening up the hole from the bottom of the conductor string or surface casing. Most wells in the center of the affected area have bell holes and engineers are now watching the time element as this might reveal how long a bell hole and gel may be effective.

This subsidence problem involving the Wilmington field is too well known to require much comment and it is being mentioned at this time because of the possibility that a number of tideland wells may be affected. Some have already been affected but reference is made to the number that as yet have not been drilled, especially in that area between the Belmont wells of Monterey Oil Co. and existing production nearer the shore line. Several excellent technical papers have been presented on the Wilmington subsidence problem but there appears to be no unanimity of opinion as to the best way to solve a difficult problem.

It is generally recognized that the subsidence is probably due to the removal of gas and fluids from the reservoir. This may or may not be true. A pilot water flood has been in operation for several years and this type of work is being expanded. The Wilmington field differs from most other California fields because it is divided into several blocks of varying size by faulting and cross faulting. Each of these blocks is a separate unit with no migration of oil or gas across the faults. Under private ownership extensive water flooding would have been done several years ago. From a political standpoint, it is a hot potato and appears to have survived some questionable engineering advice. This is not incompetent engineering but rather the failure to take advantage of such advice. The federal government's claim to all tidelands precluded constructive action and ultimately forced the City of Long Beach to impound its royalty payments. The impounding of this money prevented the harbor commissioners from undertaking corrective work in the past. In addition, no incentive was offered operators to undertake pressure maintenance because the City of Long Beach wanted the leases and wells when primary leases ran out. This is expected to be changed in 1956 by an extension of existing leases.

The Long Beach Harbor Commissioners are experiencing considerable difficulty in their efforts to cope with the relentless subsidence which has now reached an area of ship docks and piers. It has been found necessary to use heavy sheet iron, reinforced concrete bulkheads and earth dikes to keep the harbor waters from flooding vital port areas. Long Beach has spent about $25 million in subsidence remedial work and another $5 million will be required to maintain progress already made. It is possible another $50 million will be required as the problem may extend over a period of years. Approximately 16 million cubic yards of dirt has been hauled in for dikes and to raise surface elevations and another 10 million cubic yards may be needed for additional leveling purposes.

Long Beach has the distinction of having the most pronounced subsidence of any area in California and in the shortest period of time. At Long Beach, including the Terminal Island area, an area about nine square miles is sinking. Bottom of this sink is about 21 feet below the original surface of the ground. The center is near the Southern California Edison Co.'s steam generating plant. At one time it looked like the Southern California Edison Co.'s plant might become useful as a light house but new heavy foundations and dikes have at least temporarily reclaimed the plant and units. Approximately 275 producing wells of Long Beach Oil Development Co. have been raised from 18 to 20 feet and earth filled in around them to level the surface and keep the ocean water from inundating the area. This program is not yet complete and other wells in the affected area will ultimately be raised. Pumping units and other surface equipment have been raised to the new level.

The most southerly tideland project in California is at Newport, a municipality in Orange County and southeast of Huntington Beach. The operators are Monterey Oil Co. and Humble Oil & Refg. Co. The former is the operator for the City of Newport itself and Humble. These wells are drilled from a small enclosed area in the uplands several hundred feet away from the tide line. The wells are directionally drilled to intercept the tideland accumulation beneath the ocean floor. Some completions have shown good production but others have been relatively small. It is quite likely that better results would prevail if the operators could choose a more favorable location. Details of this undertaking have not been released and hence it is unknown whether the tideland pool can be exploited by an artificial island or drilling barge.

California prospectors are on the eve of embarking on a program of extensive tideland exploration and future production of the state may depend upon the success of this work. Most operators are sanguine about future possibilities but there will probably be some disappointments. It may be some time before sufficient well logs are available to give operators a clear understanding of the submerged area. Unfortunately, it may not be possible for many independent operators to undertake tideland drilling unless they are able to assemble ten or more associates because of the high cost involved. A bid of $5 million in a group of ten operators means over $500,000 each and not many operators can afford to gamble on an undertaking of this kind. In addition to the bonus bid there would be extremely high drilling costs. The next two years may prove to be an important period in California's future production. Time alone will determine the outcome. END

M. P. L. Love

M. P. L. LOVE has been appointed manufacturing vice-president of Shell Oil Co., to succeed F. S. Clulow when he retires about the middle of this year after nearly 36 years of Shell service.

Mr. Love joined Shell in 1935 as a junior chemist at the Wood River, Ill., refinery. Two years later he became a senior research chemist. He became manager of the manufacturing research department in New York in 1948. In 1951 he became manager of the Houston refinery, where he remained until August, 1954. Recently he has been on a special assignment.

Mr. Clulow was named a department manager at the Martinez, Calif., refinery in 1930 following ten years of service with Shell. In 1938 he became western manufacturing vice president with headquarters in San Francisco. In 1949 he came to New York to become manufacturing vice president for all Shell refineries.

A. E. DIETERT has been appointed assistant to the chief geologist for Cities Service Oil Co. He will have charge of the company's joint-interest exploration and development programs throughout the United States and Canada.

R. C. FREDERICK, vice president of gas sales and purchases of Pacific Northwest Pipeline Corp., Houston, has resigned. A veteran of 28 years service with Gulf Oil Corp., Mr. Frederick plans to return to Gulf. He joined Pacific in 1955.

R. B. CLAIBORNE has been promoted by Warren-Bradshaw Exploration Co., to district drilling superintendent of the company's northern Oklahoma-Panhandle district with headquarters at Pampa, Tex.

DR. JOHN E. KRASCH has ben appointed manager of research and development of American Oil Co. Dr. Kasch, formerly manager of coordination of the manufacturing department, will make his headquarters in New York. He succeeds Dr. Philip C. White, of Texas City, Texas, who recently was promoted to manager of research of Standard Oil Co. (Ind.), parent company of American.

LLOYD G. SMITH, vice president and director of Creole Petroleum Corp., has retired after 43 years of service. Mr. Smith began his career with the Standard Oil Co. (Ind.) in 1913.

In May, 1932, when the foreign properties of Pan American were purchased by Standard Oil Co. (N.J.), Mr. Smith transferred to the New York office of Standard Oil Co. (N.J.). In October, 1933, he transferred to Aruba, N.W.I. He was named a director of Creole in December, 1947.

GLENN W. POORMAN has been elected vice president of Esso Standard Oil Co. Mr. Poorman has been a director of Esso Standard since January, 1954, and was elected to the executive committee of the Esso board last Fall. He continues as contact director for the company's supply and transportation groups.

I. Q. RAYBURN, of Humble Oil and Refining Co. at Houston, has joined International Petroleum Co., Ltd., at Coral Gables, Florida, as systems and methods advisor in International's comptroller's department. He and his family will make their home in Coral Gables.

HERBERT S. CHASE, vice-president in charge of manufacturing, eastern division, Tidewater Oil Co., has retired after more than 34 years of service.

B. D. TUCKER has been named to the board of Seaboard Oil and Gas Co.

MARSHALL C. TURNER has been appointed manager of a newly-created California division of Monterey Oil Co. He will have charge of development, drilling and production throughout the California area, and will also direct the operation of the company's gasoline plant at Huntington Beach.

WILLIAM T. KNOX and Richard O. Wright have been appointed assistant division directors by the Esso Research and Engineering Co. Mr. Knox will supervise the development of improved home heating equipment and oil-fired home air conditioners. His work also will consider new outlets of petroleum.

Mr. Wright continues in the field of economics. He formerly was supervising engineer of the division's refinery economics section, a post he held since late 1954.

EDWIN W. CAMPBELL has been named marketing manager, special products and accounts in the domestic marketing department of the Gulf Oil Corp. He succeeds John P. Knight, who has been assigned to the personal staff of the vice president, domestic marketing.

LEE R. COWLES, traffic manager for Standard Oil Co. (Ind.) for 18 of his 45 years in the oil industry and railroad business, will retire Oct. 1 to become transportation commissioner for the Chamber of Commerce at Kansas City, Mo., his former home.

He joined Standard in 1937 as assistant traffic manager and became traffic manager the next year.

HOYT SHERMAN, president of Mene Grande Oil Co., the Gulf production subsidiary in Venezuela, has resigned for reasons of health. I. G. Davis, a veteran of 22 years of service with Gulf, and vice president of Mene Grande Oil Co. since 1951, has been elected to succeed Mr. Sherman.

H. R. MOORMAN, manager and executive vice president of Mobil Oil of Canada, Ltd. has been appointed a member of the Socony Mobil Oil Company's worldwide producing committee with headquarters in New York. His successor as manager and executive vice president of the Canadian affiliate, with headquarters in Calgary, will be Fred H. Moore, now assistant to the president of Magnolia Petroleum Co., Socony Mobil's southwest affiliate.

H. R. Moorman

Robert H. Milbraith

ROBERT H. MILBRAITH, a director of International Petroleum Co., Ltd., was elected a vice president following the annual meeting. He has been with Jersey Standard and its affiliates since 1934. In 1938 he was assigned to the Argentina company, from which he was granted a military leave in 1942. During the war he was responsible for military and civilian petroleum supplies in Latin America as a lieutenant commander in the Navy.

Mr. Milbrath returned to Argentina after the war as vice president and assistant general manager. In 1950 he returned to New York in Jersey's marketing coordination department and in 1952 transferred to International.

Low Transportation Cost of Supertankers

Enough supertankers, i.e., tankers of 30,000 dw tons and over, were operating in the first half of 1955 to enable an analysis of their performance to be made and for the implications of this new development to be assessed. This is done with considerable statistical detail in Westinform Shipping Report No. 56—"The Operation of Supermarkets"—issued by W. G. Ltd., London.

The report sees a total of 3,354,000 dw tons (103 vessels) in operation at the end of 1955 and, with those on order or constructing, 12,223,000 tons (353 vessels) in about four years' time, or nearly four times the present fleet. Of this total, 48% will be company owned and 52% independent. A close analysis of supertanker employment in the first half of 1955 brings out clearly its concentration on one major loading port (Mena el Ahmadi), dealing with 49% of the trade, and on one discharging port (Philadelphia) dealing with 41%.

Strong evidence is analyzed leading to a demonstration of the economy of supertankers. The Westinform review concludes that their low basic cost of transportation justifies their expected rapid growth. Data is given to support the estimate that —taking two time charter rates of $2.80 and $3.50 per ton per month—the cost of oil transport (including fuel, port charges and time charter costs) averages scale minus 20% on a $2.80 rate and scale minus 6% on a $3.50 rate. These rates are well below freight market levels except during lowest periods. Based on the present operational pattern, prospects for the anticipated rapid expansion in the number of supertankers is justified.

New Kerr-McGee Office

A new Denver office combining mining and ore processing headquarters and a metallurgical research laboratory has been opened by Kerr-McGee Oil Industries, Inc. Heading the office and laboratory is V. L. Mattson, Kerr-McGee's manager of mining and uranium ore processing.

McCollum Receives Honorary Award

L. F. McCollum, president of Continental Oil Co., has been awarded an honorary doctor of engineering degree from the Colorado School of Mines. Mines President John W. Vanderwilt conferred the degree as a part of the school's 82nd annual commencement exercises. Dr. Vanderwilt cited Mr. McCollum as "builder of industry, brilliant captain of men, civic leader and successful geologist."

Ohio Forms Overseas Company

The Ohio Oil Co. has formed a wholly-owned subsidiary, the Oasis Oil Co. of Libya, which will be operator of some 35 million acres of oil and gas exploration concessions in Libya, held one-third each by Ohio Oil, Continental Oil Co. and Amerada Petroleum Corp.

Seven Promotions by Tidewater

Seven major appointments have been made in the marketing department of Tidewater Oil Co.'s eastern division. Robert Metcalfe was named eastern divisional manager of retail sales. Joe W. Perry was named manager of the New York marketing district of the company. A. Richard Senftleben was appointed manager of the New England district. Frank A. Guerin, formerly zone supervisor in the Philadelphia area, was appointed supervisor of retail sales in the Middle Atlantic area.

Charles H. Blackburn was named zone supervisor of the Western Middle Atlantic zone. Jerome W. Hannigan was appointed sales supervisor at Pittsburgh and Albert W. Baxter was named sales supervisor in the company's newly-acquired Federalsburg, Md., territory.

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We have just thoroughly restudied over 100 oil stocks and have selected 10 as being outstanding value buys. First, these 10 stocks have huge per share underground oil and gas reserves, which, at present prices, are appraised ridiculously low—in some cases as much as 60% below their actual sales worth. Furthermore, oil is becoming increasingly difficult and expensive to find. Contrast this with a rising oil consumption rate and you see why these bonus underground oil reserves are a growing treasure for shareholders.

But that's not all. On the basis of cash earnings the real index of oil company growth, these 10 issues are cheap. One is selling for as low as a 4-to-1 price-to-cash-earnings ratio. Thus, when you find an oil company that combines huge per-share reserves with a generous cash flow in relation to price, you usually have a "double-barreled", money-making combination—a combination that more and more investors are seeking and which, we believe, means much higher market prices for these favored stocks.

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Gordon G. Wilbur

Wilbur Made Vice President

Gordon G. Wilbur has been promoted to vice president of Ideco, one of the Dresser Industries. Mr. Wilbur, who has held various key positions in Ideco sales and technical service departments during the past 16 years, will now be in charge of export sales and have general administrative responsibilities.

Morris Miller Slotnick

Morris Miller Slotnick, a geophysical consultant with Standard-Vacuum Oil Co. and widely known in the petroleum industry as a research mathematician and geophysical interpreter, died recently in Dallas, Texas, while on a business trip. He was 54 years old.

He originated and developed many of the basic and advanced methods of geophysical interpretation, including the Slotnick Method of computing refraction data. He had numerous papers published on geophysical and mathematical subjects.

George Hamlin Shaw

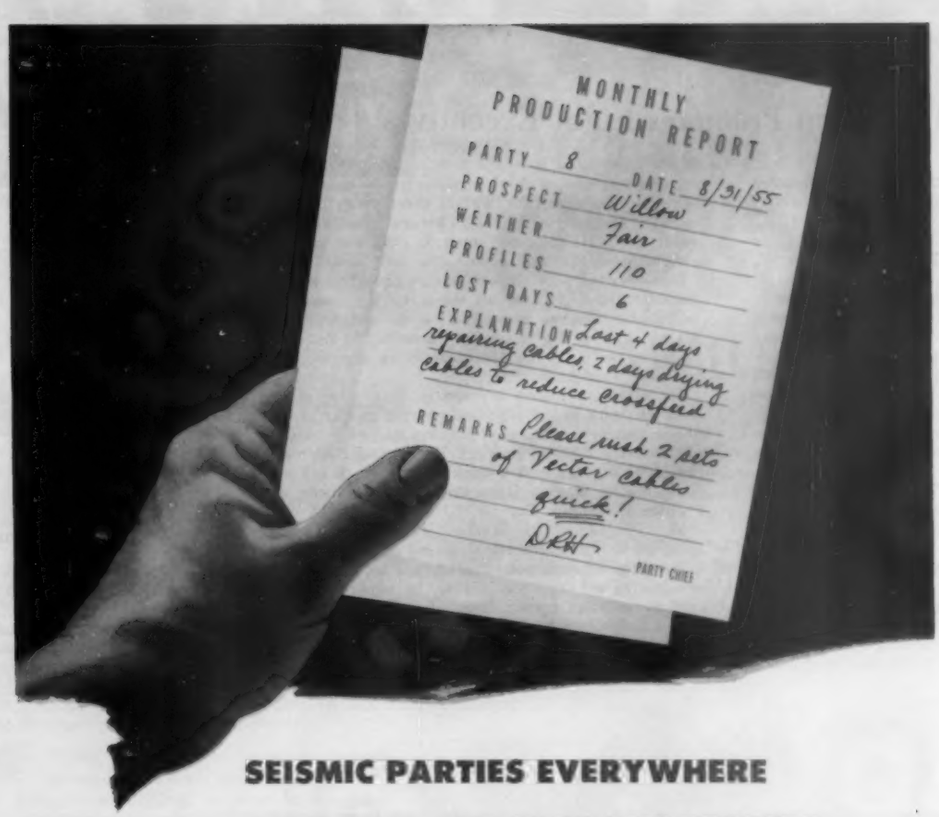
George Hamlin Shaw, a director and vice president of Cities Service Co., died April 24 of a heart attack while attending the company's annual meeting at Dover, Dela.

Mr. Shaw was made a director of Cities Service in 1936, and a vice president in January this year. He was also an industrial relations counsel of Cities Service Petroleum, Inc., and a director of Atlas Corp.

Kelly Elected Director

R. G. Kelly, vice president in charge of field operations, has been elected a director of Halliburton Oil Well Cementing Co.

R. G. Kelly



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Rex V. Phelps

Fred S. Schwend

C. E. Wharton

Warren Petroleum Promotes Eight Executives

Eight promotions and additions to the executive staff have been announced by Warren Petroleum Corp., Tulsa. D. L. Connelly, S. I. Hulse and G. L. Brennan were named senior vice presidents of their respective departments. C. E. Wharton, Rex V. Phelps, Fred S. Schwend, W. B. Padon and H. F. Beardmore were elected vice presidents.

Mr. Connelly, who has been manager of Warren's oil producing activities since 1944, becomes senior vice president in that department. He has been a vice president and director since 1952. He entered the oil industry in 1922 as a scout for the former Gypsy Oil Co. (Gulf) and later served with Indian Territory Illuminating Oil Co. as manager of its land and geological department until 1941 when he became Houston manager of land and geology for Cities Service following the ITIO merger with Cities Service. Mr. Beardmore, who has been Mr. Connelly's assistant, is another former ITIO man who later was with Amerada and Barnsdall Oil Co. He was chief engineer of Barnsdall's Mid-Continent division when he resigned to join Warren in 1947.

Mr. Hulse, who becomes senior vice president in the natural gasoline division, is a veteran in that phase of the industry. While serving as a Sinclair stenographer in the early 20's he studied engineering and was named chief engineer at the company's Seminole plant in 1927. Within three years he was assistant manager of Sinclair's natural gasoline sales department. He joined Warren in 193[illegible], was elected a director in 1939 and a vice president in 1942.

Mr. Wharton who becomes a vice president in the manufacturing department came to the company when the Hanlon companies were acquired by Warren in 1946. He was named assistant to the vice president in charge of manufacturing and in 1954 assistant vice president.

Mr. Brennan joined Warren in 1941, after more than 20 years in the liquefied petroleum gas phase of the petroleum industry. He was named manager of Warren's LPGas division. He was elected vice president in 1954 and a director earlier this year. He came to Warren from the Philgas division of Phillips Petroleum Co.

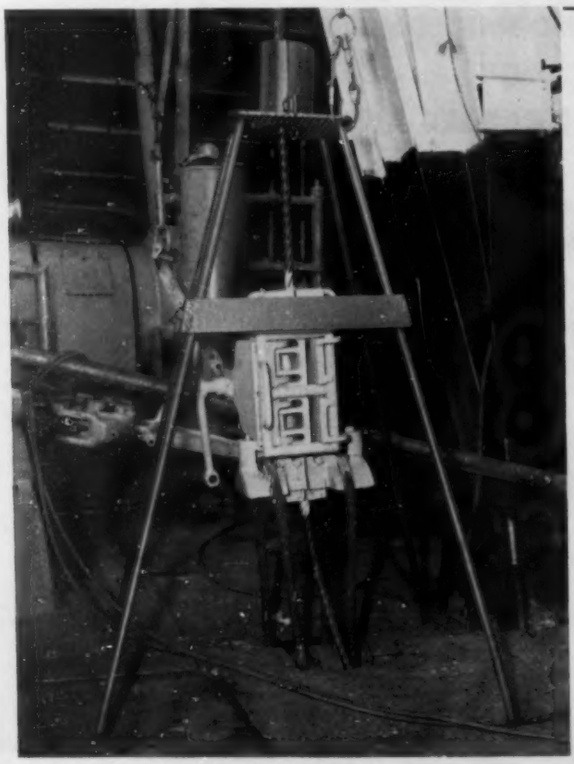
Mr. Phelps joined Warren in 1940, and was assigned to the engineering phases of natural gasoline plant construction. Transferred to the LPGas division as an engineer in 1943, he supervised the engineering and construction of bulk plants, marine transportation, terminals and inland and underground storage facilities. Early in 1955, he was named manager of the newly-formed terminal and transportation division with the natural gasoline storage, traffic, LPGas storage, marine, and engineering and construction departments under his jurisdiction.

Mr. Schwend formerly was a Phillips Petroleum Co. process engineer in the design and construction of plants. While on leave from Phillips he was production manager of the petroleum butadiene section of Rubber Reserve in 1946. Late that year he resigned to join the Warren's LPGas division. He became manager of the division in January, 1954, and assistant vice president in June of the same year. His new title is vice president, LPGas.

Mr. Padon first started working for Warren during school vacations. In World War II, he served 44 months in the Army, of which 23 months were spent overseas, during which time he rose from private to captain in the Coast Artillery. After the war he was assigned to natural gasoline sales, later being placed in charge of special products sales. His new assignment is vice president, new projects and planning.

Gerrard Named Director

Dr. John A. F. Gerrard has been named director of geophysical research in the central research division of Texas Instruments Inc. Dr. Gerrard is in charge of basic and exploratory research into technique and instrumentation for geophysical exploration for petroleum and minerals.



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12. PGAC's Jumbo coring operation is simple, fast, certain, economical—and always ready to serve you.

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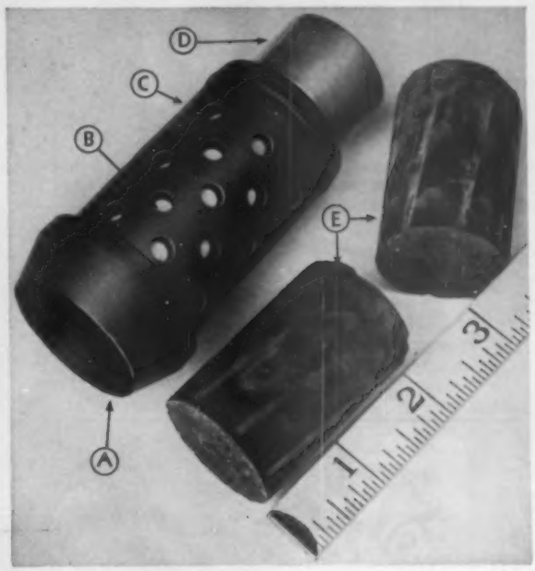

(Right) PGAC's 32-shot Jumbo sidewall coring tool.
(Above) PGAC sidewall coring projectile and cores: A—Cutter; B—Mud extrusion ports; C—Core barrels; D—Powder chamber and retrieving cable housing; E—Large PGAC Jumbo Cores.

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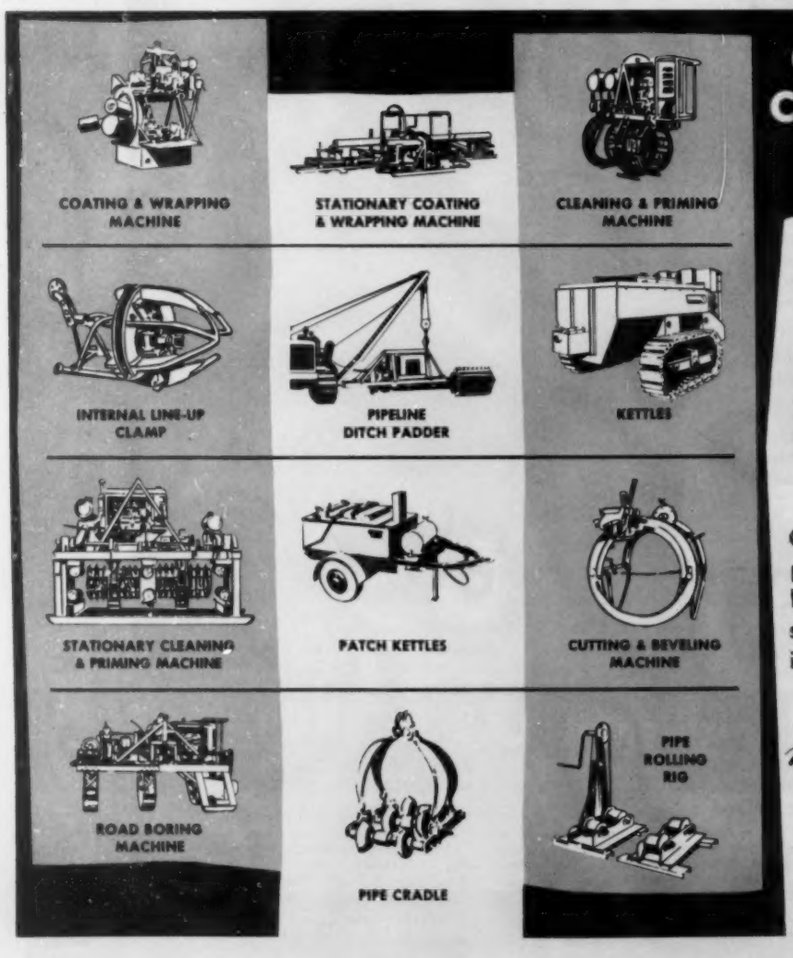
John Allen & Sons (Oxford Ltd.) 81
Howard Bull Advertising
Ashmore, Benson, Pease & Co. 91
Atlantic Refining Company 77
N. W. Ayer & Son, Inc.
Avondale Marine Ways, Inc. 5
Whitlock-Swigart, Inc.
Baash-Ross Tool Co. 88
Dozier, Eastman & Co.
Bigelow-Liptak Corporation 28
Gray & Kilgore, Inc.
British Petroleum Co. Ltd. 85
S. H. Benson Ltd.
British Thomson-Houston Co. Ltd. 16
Technical & General Advertising Agency Ltd.
Butterley Co. Ltd. 19
Rowlinson Broughton
Byron Jackson Division, Borg-Warner Corporation 73
Ramsey, Brown & Company
California Texas Oil Co., Inc. 11
Erwin, Wasey & Co., Inc.
Camay Drilling Company 105
The Cape Asbestos Co. Ltd. 106
Taylor Advertising Ltd.
Catalytic Construction Company 54
Doremus-Eshleman Company
Chicago Bridge & Iron Company 7
Russell T. Gray, Inc.
Cities Service Oil Co. 15
Ellington & Co., Inc.
Clark Bros. Company 31
The McCarty Company
M. J. Crose Mfg. Co., Inc. 104
Paul Locke Advertising, Inc.
Dowell Incorporated 89
MacManus, John & Adams, Inc.
Dunlop Rubber Co. Ltd. (Dunlopillo) 72
Chas. F. Higham Ltd.
E. I. du Pont de Nemours & Co., Inc. 17-18
Charles L. Rumrill & Co., Inc.
Ethyl Corporation 1
Batten, Barton, Durstine & Osborn, Inc.
Geolograph Company 105
Lowe Runkle Company

ADVERTISERS' INDEX

(Advertising Agencies in Italics)

Geophysical Service, Inc. 30
Auld Advertising
Halliburton Oil Well Cementing Company 36
Hill & Christopher, Inc.
Houdry Process Corporation 90
Arndt, Preston, Chapin, Lamb & Keen, Inc.
International Harvester Export Company 27
McCann-Erickson, Inc.
M. W. Kellogg Company 12
Fuller & Smith & Ross, Inc.
Richard Klinger Ltd. 83
R. F. White & Son Ltd.
Lafarge Aluminous Cement Co. Ltd. 3
Allardyce Palmer Ltd.
Lucey Export Corporation 26
Sam J. Gallay Advertising
The Lummus Company 34
G. M. Basford Company
Magnet Cove Barium Corporation Cover III
Rives, Dyke & Company
Manning, Maxwell & Moore, Inc. 29
Fuller & Smith & Ross, Inc.
McCullough Tool Company 2
Raymond O. Perry Advertising
Lee C. Moore Corporation 87
Paul Locke Advertising
Murray & Tregurtha, Inc. 78
Roy Elliott Company
The New Deal Specialty Co. 102
Gibbons Advertising Agency, Inc.
Oil Center Tool Company Cover IV
Rives, Dyke & Company
Oil Statistics Co., Inc. 100
Joan M. Koob Associates, Inc.
Samuel Osborn & Co., Ltd. 105
The Ralph M. Parsons Company 79
Dozier, Eastman & Co.
Perforating Guns Atlas Corporation 103
J. F. Brinley Advertising Agency
Petty Geophysical Engineering Company 94
Claude Aniol Associates
The Power-Gas Group 91
D. & C. and Wm. Press Ltd. 24
Taylor Advertising Ltd.
Procon, Incorporated 22
Sam J. Gallay Advertising
Reed Roller Bit Company 71
Brennan Advertising Agency
Santa Fe Drilling Company 96
Dozier, Eastman & Co.
Schlumberger Surenco 53
Rives, Dyke & Company
Security Engineering Division, Dresser Operations, Inc. 21
The McCarty Company
Socony Mobil Oil Co., Inc. 25
Compton Advertising, Inc.
Peter Spence & Sons Ltd. 93
Ripley Preston & Co. Ltd.
Standard Oil Company (New Jersey) 32
McCann-Erickson, Inc.
Standard-Vacuum Oil Company 13
Sam J. Gallay Advertising
Timken Roller Bearing Company 23
Batten, Barton, Durstine & Osborn, Inc.
Unit Crane & Shovel Corporation 97
Paulson-Gerlach & Associates, Inc.
United Air Lines 92
N. W. Ayer & Son
Universal Oil Products Company 8-9
Sam J. Gallay Advertising
Vector Manufacturing Company 101
Publication Service Company
Warren Petroleum Corporation Cover II
Chapman Company
Waukesha Motor Company 20
John G. Robel
G. & J. Weir Ltd. 72
Scottish Industrial Advertising
Westinghouse Electric International Company 75
Ellington & Company, Inc.
Williams Brothers Corporation 95
Scot's Advertising



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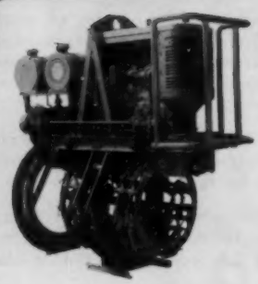

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